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STAFF

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THE SHOCK AND VIBRATION
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Code 5804, Naval Research Laboratory
Washington, D.C. 20375

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SVIC NOTES

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DIGITAL EQUIPMENT IN THE TEST LAB

Five and one half years ago, the Shockand Vibration Information Center, Goddard Space Flight Center and the Jet Propulsion Laboratory jointly sponsored a meeting. The meeting was called a Seminar on Understanding Digital Control and Analysis in Vibration Test Systems.* It served a very useful purpose at that time; a lot of new digital control/analysis test equipment was being put on the market and many analogue people needed information in a hurry. The seminar filled this need. That was quite some time ago and much has happened since then.

Looking at those proceedings recently and reflecting on what was said there I noticed a few new trends. Today there are more companies making and selling similar types of equipment – you have more of a choice of options and systems to pick from. The equipment is becoming more reliable and more portable. It is also becoming more software oriented. Many companies now have a fairly powerful minicomputer as the backbone of their systems. They might be using a system to run a random, sine or shock test, to do a modal analysis or process time series test data, all under control of a computer.

The most interesting new trend is that due to the use of off-the-shelf minicomputers most of the programs are written in open code. You can get a copy of the programs and modify them if you want to.

This is going to be the trend; more and more users are going to write and modify their programs. The twenty-four-dollar question is – must everyone reinvent the wheel or is there some way to tap into the existing body of knowledge? In what ways could information be codified, packaged and transferred to the shock and vibration community? Several options come to mind which we at SVIC could help to get organized.

We could recycle a special seminar on digital control and analysis test equipment, emphasizing the software part of the business.

There are a dozen or so topics suitable for literature reviews such as modal analysis, animated displays, etc. These could be published in the DIGEST.

Users groups could be formed for the purpose of sharing information. They could meet at our yearly Shock and Vibration Symposium. Also, special sessions could be orchestrated at the Symposium.

A special publication might be put together where each chapter could be written by one or more experts on a specific topic. SVIC has in the past coordinated the publication of multi-author documents as well as a series of monographs.

There are many options which come to mind and I would like to hear what other members of the shock and vibration community think on this subject. If you would like to write a paper, a literature review, participate in a panel session or special seminar or just discuss the options we would like to hear about it from you.

J.G.S.

* *Seminar on Understanding Digital Control and Analysis in Vibration Test Systems, published by U.S. Naval Research Laboratory Shock and Vibration Information Center, Washington, D.C., Parts 1 and 2 (May 1975).*

EDITORS RATTLE SPACE

COMPUTER CAPABILITY CONTINUES TO GROW

The seemingly endless development of computational capability for analysts continues to amaze me. It appears that hardware development is proceeding at a much faster pace than the ability of individuals to efficiently utilize it. At the present time NASA is proposing to build a super computer capable of 1 x 10^9 operations per second and having a memory of 240,000,000 words. The most advanced computer today is about 1/12 as fast and has only 1/64 the memory. The object of having this capability is to effect a complete solution of the three-dimensional Havier-Stokes equations describing aircraft flow fields.

Although the majority of engineers are not interested in the super computer, the technology involved in its development will be incorporated into smaller machines such as minicomputers and programmable calculators. It is notable that engineers do have good accessibility to large mainframe computers – probably more so than to minicomputers. And, the large mainframe computer now gives the engineer the capability of finding cost-effective solutions to many practical problems involving transient phenomena and complex models. Parallel to the evolution of the capability of the mainframe computer has been that of the minicomputer. It is now possible to solve such routine problems as machine critical speeds on a minicomputer. Even fluid-film bearing stiffness and damping values can be computed. From the work I have personally seen, the graphics capability of the minicomputer, including four-color plots, exceeds that generally available with large mainframe computers.

The new generation of programmable calculators provide the engineer with the portable, instantaneous computation at a very reasonable hardware cost. The programmable calculator is no longer a toy able only to numerically solve simple algebraic expressions but a tool capable of carrying out many of the computational and logic operations of large computers – even small matrices can be inverted. Programming logic can be applied to the solution of problems much larger than the single degree-of-freedom system. These small calculators also have graphics capability.

A great deal of cost effective computing power has been placed at the disposal of the engineer. I believe that it should be used not only to solve problems involving larger models but also to increase productivity in engineering analysis and design.

R.L.E.

VIBRATION ANALYSIS OF HIGHWAY BRIDGES

H.V.S. GangaRao and C.A. Haslebacher*

Abstract. This article is divided into two main sections: one deals with the vibrations and deflections of highway bridges; the other deals with human tolerance to bridge vibrations. Experimental work and theoretical analyses of vibrations and deflections are reviewed in the first section. The second section describes the literature on human tolerance levels for highway bridge vibrations and suggests certain limits as functions of bridge and vehicle parameters to prevent amplitude levels that could lead to intolerability.

The displacement of a bridge superstructure due to truck live loadings has been the subject of many investigations in recent years. Vibrations and deflections due to dynamic loading can produce strains and stresses in a bridge superstructure that exceed equivalent static loadings. Much of the research on dynamic behavior has been concerned with assessing the magnitude of these dynamic stresses and strains.

Dynamic loadings can also lead to vibrations, the amplitudes and frequencies of which cause discomfort to pedestrians on bridges but do little to increase superstructure stresses. Research in this area has been limited due to the large number of variables that must be considered. The major objective of this article is to briefly review the existing literature of deflections and vibrations of highway bridges and of human tolerance to bridge vibrations.

DEFLECTIONS AND VIBRATIONS

The problem of bridge vibrations and deflections first became apparent during the mid-1880s as heavier and faster rail vehicles came into use. The first analysis of the problem was conducted by Willis [29]. He attempted to simplify the analysis by considering only the mass of the moving load. In the equation that he developed, the deflection could be obtained using an equation for static deflection in which the load was a function of its path along a beam. An exact solution of the equation was obtained by Stokes [20], who used a power series. An approximate solution was obtained by adding an additional term to the static equation. The additional term served as an impact factor.

The problem of bridge vibration was investigated by Timoshenko [22, 23] in 1922. He listed three major causes of vibrations in railroad bridges: live-load effect of a smoothly rolling load, impact effect of the balance weights of the locomotive driving wheels, and impact effect due to irregularities of the track and the flat spots on the wheel. Timoshenko considered two possible extreme cases of the live-load effect: that the mass of the moving load is either large or small in comparison to the mass of the beam. The equations for solving the case in which the mass is large were similar to those proposed by Willis as part of his investigation of railway bridges. For the case in which the mass is small Timoshenko derived equations in which the load could be modeled as a moving force. He pointed out that the impact effect of unbalanced wheels can lead to a state of structural resonance when the number of revolutions per second of the driving wheels approaches the natural frequency of the bridge. The impact effect of track irregularities was also considered as the additional dynamic loading associated with an uneven road surface. Timoshenko defined major parameters that must be considered in analyzing dynamic effects on highway bridges. The parameters include ratio of mass of load to mass of vehicle, resonance, and road surface irregularities. Timoshenko's investigation on dynamic loadings was based on analyses of railway bridges, but the assumption of negligible mass of applied or truck loads makes them applicable to analyses of highway bridges.

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Schallenkamp [18] presented a rigorous solution for dynamic bridge vibration that took into account the beam and load masses. His solution has not received widespread acceptance, however, because it is not in a convenient form for computation.

Research with respect to highway bridge vibrations has been conducted in an attempt to relate experimental results to theory or to try to isolate significant bridge parameters. In 1956 the Highway Research Board published a Bulletin that contained a survey of all the significant research to that time. Articles in the Bulletin discussed important aspects of bridge vibration research. For example, Biggs and Suer [2] presented results of field measurements of dynamic deflections of six simple span bridges. The maximum observed amplitudes of vibration for the test bridges varied from 18% to 40% of the maximum static deflection. Biggs and Suer categorized the causes of dynamic deflections as passage of a smoothly rolling mass across the span, vibration of the vehicle on its suspension system, and sharp surface irregularities on the structure. They concluded that the most important factor affecting the amplitude of vibration is the oscillation of the load on its suspension system.

Scheffey [19] discussed the significance of various dynamic parameters associated with the design of highway bridges. He concluded that the dynamic response becomes critical when the frequency of a vehicle approaches the natural frequency of a bridge. He also noted that the superposition of the effects of more than one load is very difficult to quantify.

Hays and Sbarounis [11] obtained information on the dynamic characteristics of three-span continuous I-beam bridges. The effects of load and composite action on the natural frequency of bridges were investigated. They also concluded that a critical loading results when the frequency of a vehicle approaches the natural frequency of a bridge-vehicle system. Studies by Edgerton and Beecroft [3] on two three-span continuous plate bridges in Oregon revealed that the amount of vibration can be affected by deck roughness.

Finally, much work has been done at the University of Illinois on the effects of dynamic loading and impact [25, 27]. Both analytical and experimental studies were done on simple span and continuous span bridges. The objective of those studies was "to assess the relative importance of various factors that influence the dynamic stresses of highway bridges and to obtain information which will be useful as a guide in the proper selection of impact factors in highway bridge design" [27]. The equations of motions of the idealized bridge-vehicle system were derived using energy methods; an infinite number of nonlinear equations of motion resulted. Previous methods of circumventing this problem of an infinite number of equations were not adopted; Inglis [13], for example, had neglected the higher modes of oscillation, and Timoshenko assumed that the effect of a constant mass traversing a beam could be idealized as a constant force. Veletsos and Huang [27] chose to conduct an experimental analysis to determine if "some experimental observation might be able to show a way to arrive at some basis for a more rational and simplified analysis." The experimental analysis revealed that a close approximation of the equation of motion could be obtained by assuming that the dynamic deflection is a product of the deflection at any point of a simple beam under a concentrated force acting at point ξ (ξ = vehicle velocity x time traveled on the bridge) and an arbitrary factor that varies with time but is independent of any location.

In another study [25] the effects of damping, camber, and roadway unevenness were considered; however, in the approximate solution these parameters were neglected. The parameters that directly influence the calculations were reduced to the following ratios: (a) weight of unsprung part of vehicle to bridge weight, (b) weight of sprung part of vehicle to weight of bridge, (c) weight of vehicle to weight of bridge, (d) natural frequency of vehicle to that of bridge (stiffness parameter), and (e) velocity of vehicle to span length times twice the natural bridge frequency (speed parameter).

A good correlation was obtained between the analytical and experimental results. From this research, the University of Illinois research team concluded that the impact effect was unusually less than 30% for the practical parameter range of highway bridges.

Similar studies to determine the significant parameters that affect the dynamic behavior of bridges have been done [4, 5, 15, 28]. Fleming and Romualdi [4] concluded that the most important factor for unsprung loads is the speed of the load.

Wen and Veletsos [28] divided the important factors into those related to the behavior of the bridge and those associated with the unevenness of the bridge surface. The first category included the speed of the vehicle, axle spacing, and the initial oscillation of the bridge. The second category included the initial oscillation of the vehicle and the characteristics of the bridge surface.

Linger and Hulsbos [15] showed qualitatively that the amount of impact is a function of the ratio of the frequency of axle repetition to the loaded natural frequency of the structure. They idealized "the vehicle as an oscillating forcing function whose frequency is the frequency of axle repetition and whose oscillating force is the oscillating load effect of a constant force." Good correlation between the theoretical and experimental values was achieved using this method.

The concepts of Linger and Hulsbos [15] were extended to modeling moving trucks as a harmonic motion and utilizing the macro flexibility approach for continuous systems [6]. GangaRao [6] derived design equations for displacements and moments of a continuous bridge system with support settlements under steady state harmonic vibrations. He claimed that a more representative dynamic analysis, related to true bridge vibrations, can be performed through his approach [7] than the one based on the AASHTO (American Association of State Highway and Transportation Officials) specifications. This improvement has been attributed to the fact that such problem parameters as forcing and natural frequencies, mass and stiffness of the structures, and velocity and axle spacing of the vehicle are properly incorporated in the derivation of design equations.

It is apparent from the literature that the complexity of bridge-vehicle interaction has hindered researchers in their attempts to isolate the major parameters that affect dynamic behavior. Several contradictions concerning the importance of particular parameters have made it difficult to draw any general guidelines for design. This difficulty is reflected by the fact that current highway bridge specifications by AASHTO treat the problem of dynamic loading indirectly. An impact factor is added to the static loading case; the impact factor is defined as a ratio of 50 over the span length plus 125. The major limitation of this relation is that the empirical equation is dependent only on the span length and on no other bridge parameter.

A recent report [32] suggested no changes in the basic equation on impact given in the AASHTO specifications [1]. Even though various studies [16, 21, 26, 27, 32] provide an excellent basis for refinements, additional field data on modern structures must be collected before current provisions on impact can be refined.

An interesting design feature of a bridge system is the dynamic interaction of the moving vehicles and the bridge superstructure. In the past this problem had been analyzed as a moving force approximation; i.e., neglecting the transverse inertia of the moving mass particle. This is an excellent approximation so long as the mass particle is traveling at a low speed and the particle mass has a much smaller value than the beam mass. In the recent past, however, a need arose for a refined analysis that includes a complete kinematic description of the interaction of the moving vehicle and its guideway. This is particularly evidenced by the fact that new structures such as rapid transit vehicles allow for higher live to dead load ratios and increasing vehicle speeds. The interaction of moving vehicle and guideway has been dealt with extensively [9, 17, 24, 30]; it is beyond the scope of this article to provide additional details.

HUMAN TOLERANCE TO BRIDGE VIBRATION

The first major investigation of human sensitivity to vibration as it applies to bridge vibration was conducted by Wright and Green [31]. They surveyed significant investigations on human response to vibration and compared them to measurements on 52 bridges. They used the results of their investigations and previous research to develop charts of human perception to vibrations of varying amplitude and frequency [10]. They concluded that the problem was so complex that quantitative rather than qualitative methods must be employed to evaluate the effects of bridge vibrations on humans.

Leonard [14] listed four developments in bridge design that increase the likelihood of vibrations in the structure: refinements in structural analysis and improving knowledge of material properties; wider use of prestressed concrete, composite con-

struction, and all welded structures; goods vehicles of higher weights and capable of greater speeds; and current aesthetic tastes requiring more slender lines in structures. Leonard reviewed the available literature on human tolerance to vibration and noted that "the human body is so sensitive to vibrations, that in general, limits of tolerance are reached at levels which are less severe than would normally give rise to distress in bridge structures." From the review of available literature and tests performed at the Road Research Laboratory in England, Leonard concluded that current specifications address only the problem of dynamic stresses and neglect such structural properties as frequency, acceleration, amplitude, and damping. Dynamic design is handled indirectly by such provisions as the AASHTO or OHBDC limits on depth-span ratios and live load deflection [1, 16].

Leonard suggested that one method for reducing dynamic vibrations would be to insure smooth road surfaces so that effective dynamic loading could be reduced. In addition, he noted that current criteria on live-load deflection and depth-span ratio criteria are not sufficient to prevent large vibrations. He recommended that provisions should be made for sufficient structural damping to reduce vibrations. This is difficult to accomplish, however, because structural damping is one of the least predictable factors in bridge design.

As is the case with dynamic stresses, human tolerance to vibration is a very difficult concept to accurately quantify with simple design equations. The complexity of the situation necessitates simplifications to reduce the analysis to a more manageable form. The available literature indicates the importance of the problem [4, 7]; limits on riding quality are established on the basis of existing information.

Field studies and evaluations of 20 bridges for tolerable/intolerable limits on the basis of riding quality [7, 8] have resulted in the following classifications: Group I, intolerable due to poor riding quality; Group II, intolerable for reasons other than poor riding quality; and Group III, tolerable. These classifications, which are based on field data, are compared with those obtained from the literature [7, 8].

A zone of intolerability (based on human response levels) given by Wright and Green [31] is given as a function of the ratio of the forced (ω_f) to the natural (ω_n) frequencies. Because a substantial increase in deflections leading to uncomfortable levels of human response is observed for ω_f/ω_n ranging from 0.5 to 1.5, special design consideration should be given to problem parameters so that magnitudes of deflection can be minimized. For a value of ω_f/ω_n less than 0.5 or greater than 1.5, tolerability aspects need not be analyzed. It should be noted, however, that accurate analysis considering damping, interaction between the vehicle and the bridge, road roughness, and two-dimensional behavior of the system must be performed for cases in which ω_f/ω_n falls very close to 0.5 or 1.5.

Data for vehicular traffic on roads and bridges [12, 14, 31] reveal that ouput peak velocity does not change drastically with varying vehicle speeds. However, a significant change in peak velocity can be attributed to such changes in deck surface conditions as a ramp or bumpy surface [12]. The results indicate a maximum of 20% increase in forcing frequency from a normal road surface to a ramp-surface condition. Hence, GangaRao, et al [7] proposed that the forcing frequency with ramp effects, ω_{fr} be taken as 1.2 ω_f.

CONCLUSIONS

The existing literature on theoretical and experimental analysis of highway bridge vibrations is extensive. A number of research articles since the middle of the 19th century have dealt with the vibration and deflection of railway and highway bridges and on establishing impact factors. These aspects are critically reviewed in this article; special emphasis is given on research conducted at the University of Illinois.

Researchers have recently attempted to isolate the major parameters that affect the dynamic interaction of a bridge superstructure and moving vehicles by properly accounting for the transverse inertia of the moving mass particle. Transverse inertia could be critical for elevated structures carrying rapid transit vehicles because higher live load to dead load ratios and increasing vehicle speeds are required.

The effect of traffic-induced vibrations on people and bridge structures has been surveyed and compared with the effects of vibrations from other

sources. With the advent of slender bridge designs due to the availability of high strength materials, traffic-induced vibrations on bridges have become more noticeable. Simple methods of dynamic analysis and limits on amplitudes of vibrations have been suggested to properly account for dynamic stresses generated by vehicles and the reaction of pedestrians.

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LITERATURE REVIEW: survey and analysis of the Shock and Vibration literature

The monthly Literature Review, a subjective critique and summary of the literature, consists of two to four review articles each month, 3,000 to 4,000 words in length. The purpose of this section is to present a "digest" of literature over a period of three years. Planned by the Technical Editor, this section provides the DIGEST reader with up-to-date insights into current technology in more than 150 topic areas. Review articles inlcude technical information from articles, reports, and unpublished proceedings. Each article also contains a minor tutorial of the technical area under discussion, a survey and evaluation of the new literature, and recommendations. Review articles are written by experts in the shock and vibration field.

This issue of the DIGEST contains an article about underwater acoustic modeling techniques.

Mr. P.C. Etter of MAR Incorporated, Rockville, Maryland, has written a state-of-the-art literature review of underwater acoustic models developed by the Navy sonar modeling community. Three types of acoustic models are addressed: propagation loss, noise, and active sonar/reverberation models. Basic features of each type of model and areas of application are discussed. Problems associated with model evaluation and validation are described.

UNDERWATER ACOUSTIC MODELING TECHNIQUES

P.C. Etter*

Abstract. This paper presents a state-of-the-art literature review of underwater acoustic models developed by the Navy sonar modeling community. Three types of acoustic models are addressed: propagation loss, noise, and active sonar/reverberation models. Basic features of each type of model and areas of application are discussed. Problems associated with model evaluation and validation are described.

The field of underwater acoustics has been extensively developed over the last four decades in response to practical needs originating within the sonar and seismic communities [1]. Since 1960 considerable emphasis has been placed on the development of mathematical models to analyze data collected during field experiments. These models have historically been used to predict acoustic conditions for application to various problems including the planning of improved at-sea experiments and the designing of optimized sonar systems. However, although the underlying theories have been well developed for some time, the transition from theory to operational computer models has not progressed as rapidly. This lag can be attributed to a number of factors; these include limitations in existing computer capabilities, a lack of adequate mathematical methods, and insufficient environmental-acoustic data of suitable resolution for proper support of model validation.

The emphasis in this review will be directed at those underwater acoustic models developed by the Navy sonar modeling community over the past several years. Although reviews of acoustic models are not new [2-4], the scope of the present paper is apparently unique in that it embraces three broad types of models comprising propagation loss, noise, and active sonar/reverberation models. The breadth of this review precludes detailed discussions of any particular model type. Rather, the intent is to acquaint the reader with the availability of the state-of-the-art acoustic models.

A more fundamental category of models, not fully described here, is environmental models. This category includes empirically-derived models that are frequently used as integral parts of acoustic models to generate input parameters or predict intermediate quantities. Examples of such models currently in use include sound speed [5-9], absorption coefficients [10-12], surface reflection losses [13], bottom reflection losses [14], surface backscattering strengths [15, 16], bottom backscattering strengths [17, 18], volume scattering strengths [19], ambient noise [20], and surface duct propagation loss [13].

The acoustic models discussed here are generally restricted to those mathematical models of acoustic theory that have been converted to computer codes for application to well-defined sonar-related problems. The scope of this review necessarily precludes citations of that literature which, protected by national security provisions, lies outside the public domain. Thus, it can be assumed that certain areas of acoustic modeling will be advanced beyond the level of sophistication depicted here.

Irrespective of acoustic model type, the intended applications will fall into one of two basic categories: research or operational. The research-oriented modeling techniques are developed for investigative studies in laboratory environments where accuracy is important, computer time is not a critical factor, and facilities are supportive of the modeling efforts. Operational-oriented models are those that support field activities, including Fleet operations, and must be executed rapidly, often under demanding conditions. In this latter situation, model accuracy may be subordinate to processing speed.

The three types of acoustic models will be described below. The first type of model, propagation loss, is a fundamental building block for ambient noise and active sonar/reverberation models. Furthermore,

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propagation loss models, together with noise models, reverberation models, and environmental models are components of the active sonar models.

PROPAGATION LOSS MODELS

This section describes those stand-alone acoustic propagation loss models that are applicable to passive sonar systems.

Formulations of acoustic propagation loss models generally begin with the three-dimensional, time-dependent wave equation. However, the wave equation is derived from the general equations of continuity, state, and motion. Consequently, depending on the governing assumptions and intended applications, the exact form of the wave equation can vary considerably [21, 22]. For most applications, however, a simplified linear, hyperbolic, second-order partial differential equation is used:

$$\nabla^2\phi = \frac{1}{c^2}\frac{\partial^2\phi}{\partial t^2}$$

where

∇^2 = Laplacian operator

ϕ = field variable

c = speed of sound

t = time

Subsequent simplifications frequently incorporate a harmonic solution in order to obtain the time-independent Helmholtz (or elliptic reduced) wave equation. Without such simplifications, general solutions to the wave equation with non-trivial boundary conditions are usually limited to iterative finite difference techniques [23].

Various theoretical approaches are applicable to the Helmholtz equation. The approach used depends on the specific geometrical assumptions made for the propagation and the type of solution chosen for ϕ.

Although acoustic propagation loss models can be classified according to the theoretical approach employed, the cross-connections that exist among the various approaches complicate a strict classification, or taxonomic, scheme. Consequently, the more detailed the scheme, the more incestuous the approaches appear [3]. A generalized classification scheme has been constructed on the basis of five theoretical approaches [2, 3]. The approaches can be reduced to two major categories: ray models and wave models.

The breakdown of model approaches into these two basic categories affords a simplistic but useful classification mechanism. Specifically, ray models are generally fast-funning, simply-executed programs that are valid over a broad range of frequencies. The wave models, on the other hand, are generally more accurate than the ray models but require longer running times and more operator intervention; in addition, the wave models are usually limited to acoustic frequencies below about 300 Hz. It is not surprising, therefore, that the ray models are most closely associated with operational applications, and the wave models are most frequently applied to research problems. This particular classification scheme has been used in earlier work [24].

Within the categories of ray and wave models, a further subdivision can be made into range-independent and range-dependent types. Range-independence means that the model assumes cylindrical symmetry for the environment (i.e., a horizontally stratified ocean). Range-dependence indicates that some properties of the ocean medium are allowed to vary as a function of range from the receiver. Such range-varying properties commonly include sound speed and bathymetry.

The five theoretical approaches mentioned earlier are grouped according to ray or wave models as follows:

<u>Ray Models</u>

- ray theory with corrections
- multipath expansion techniques

<u>Wave Models</u>

- normal mode solutions
- fast field theory
- parabolic approximation

These approaches are discussed in more detail below.

Ray Models. Ray models calculate propagation loss principally on the basis of ray-tracing. As a result much attention has been devoted to the manner in which the sound-speed profile is approximated and the method by which earth-curvature corrections are applied to the profile.

Ray theory with corrections starts with the Helmholtz equation. The solution is then separated into amplitude and phase components under the assumption that the amplitude varies more slowly with position than does the phase (geometrical acoustics approximation). This assumption limits the method to the high frequency domain. However, with appropriate frequency-dependent corrections and proper evaluation of caustics, the theory can be extended to lower frequencies [25-32]. Extensions to range-dependence can be accomplished in several ways: by mapping rays over discrete range intervals in which the environment remains constant [33-36], by dividing the range-depth plane into triangular regions [37-40], or by allowing the environment to vary smoothly as a function of range [41, 42].

Multipath expansion techniques expand the acoustic field integral representation of the wave equation in terms of an infinite set of integrals, each of which is associated with a particular ray path. This method has also been referred to in the literature as the WKB method because a generalized WKB technique is used to solve the depth-dependent equation derived from the normal mode solution. Each normal mode can then be represented by corresponding rays [43]. To date, this technique has not been extended to range-dependent environments.

Models categorized as ray models are summarized in Table 1(a) together with references to available documentation.

Wave Models. Wave models either expand the acoustic field integral in terms of a discrete set of normal modes or numerically integrate the wave equation.

Normal mode solutions assume that the solution to the Holmholtz equation is the product of a depth-dependent Green's function and a range-dependent Bessel function. The depth-dependent function is composed of trapped modes and continuous modes. Using Cauchy's residue theory, the trapped (or discrete) modes correspond to a sum of residues; the continuous mode spectrum is associated with a branch cut integral [44, 45]. Extensions to range dependence are accomplished either by mode coupling [46, 47], which considers the energy scattered from a given mode into other modes, or by invoking the adiabatic assumption [48-55], which assumes that all energy in a given mode transfers to the corresponding mode in the new environment, provided that the environmental variations in range are gradual. One model [55] allows for cross-track variations as well.

Fast field theory separates the wave equation parameters according to the normal mode approach by a Hankel transform of the Helmholtz equation with respect to range. The resulting transform is then numerically evaluated using a Fast Fourier Transform (FFT) algorithm [56-58]. This method requires that the sound speed vary exponentially with depth within each layer of the model. Models based on fast field theory do not allow for environmental range dependence.

The parabolic approximation method replaces the elliptic reduced wave equation with a parabolic equation under the assumption that the ray paths are almost horizontal. Solutions to the parabolic equation are commonly generated using the split-step algorithm [59-61]. Some methods partially correct for the parabolic approximation [61]. The computational advantage of the parabolic approximation lies in the fact that a parabolic differential equation can be marched in the range dimension; on the other hand, the elliptic reduced wave equation must be numerically solved in the entire range-depth region simultaneously [62]. However, the implementation of the approximation is complicated by the fact that the solution at the starting range must be calculated by another method. All models reviewed here using the parabolic approximation allow for environmental range dependence. Models categorized as wave models are summarized in Table 1(b) together with references to available documentation.

One of the more pressing problems in the area of propagation loss modeling is the proper accounting of bottom interaction phenomena. Current approaches are leaning toward geophysical representations of the sea floor for the modeling of bottom reflection and refraction of sound.

Table 1. Summary of Propagation Loss Models

(a) Ray Models

Range-Independent	Range-Dependent
FACT [30, 31]	FACTEX [33]
FLIRT [25]	Four Segment Ray Tracing Model with Range Dependency [34, 35]
Moving Source Simulation [26-29]	GRASS [41, 42]
PLRAY [32]	MPP [37]
RAYMODE X [43]	RAYWAVE II [38, 39]
	SHALFACT [36]
	TRIMAIN [40]

(b) Wave Models

Range-Independent	Range-Dependent
FFP [56, 57]	ASERT [48]
Kutschale FFP [58]	ASTRAL [49, 50]
NLNM [44]	Kanabis Shallow Water [46, 47]
NORMOD 3 [45]	MOATL [51-53]
	PAREQ [59]
	PE [60]
	Corrected PE [61]
	SNAP [54]
	Three Dimensional Ocean Acoustics Model [55]

NOISE MODELS

For purposes of the present discussion, noise models can be segregated into two separate but closely-related types: ambient noise models and beam-noise statistics models. Ambient noise models predict the mean levels sensed by an acoustical receiver when the noise sources include surface weather, biologics, and such commercial activities as shipping and oil drilling [63-67]. Beam-noise statistics models predict the properties of low-frequency shipping noise. The latter models use either analytic (deductive) or simulation (inductive) techniques to arrive at statistical descriptions of the beam-noise. In this context, beam-noise is the convolution of the receiver beam pattern with the sum of the intensities from the various noise sources [4]. The analytic models [68-73] calculate statistical properties directly from the components (e.g., source level, propagation loss); the simulation models [74, 75] use Monte Carlo or related techniques.

Noise models can be further differentiated by their treatment of the noise sources, the propagation loss, and the receiver response, as discussed below. Noise sources can be treated as either variable densities or as discrete sources.

Propagation loss can be computed internal to the noise model or input externally from other model predictions or from field data. Furthermore, the propagation loss must be specified either as range-averaged or as point-to-point to be consistent with the specification of the noise sources.

Receiver response determines the noise field directionality information required for application to either vertically or horizontally oriented receiver arrays. Models categorized as noise models are summarized in Table 2 together with references to available documentation.

ACTIVE SONAR/REVERBERATION MODELS

Reverberation models and active sonar models have been grouped together because it is extremely difficult to separate reverberation models from specific active sonar system applications. As mentioned earlier, active sonar models are composed of smaller modules: environmental models, propagation loss models, noise models, and reverberation models. In addition, active sonar models incorporate echo level models and signal processing models [76-88].

Reverberation models generally predict three different types of reverberation depending on the location of the scatterers (i.e., volume, surface, or bottom). The volume scattering can be treated as a layered function of depth or as an integrated column strength. The principal cause of volume reverberation in the ocean is the existence of migrating biological scatterers [19]. Consequently, measurements of volume scattering strengths as a layered function of depth are not considered stable enough for many sonar applications; therefore, the integrated column strength formulation is generally used [83].

The reverberation models can be differentiated by their treatment of source/receiver geometries, backscattering formulations, the method of computing reverberation ray paths (e.g., straight line or refracted), the number of reverberation ray paths examined, the manner in which the ensonified volume is divided (e.g., on the basis of time or range), Doppler gain, and computation of power spectra.

All active sonar/reverberation models reviewed here use specialized ray models to predict propagation loss. The multipath expansion technique is used in one case [79]; all other models employ ray theory with corrections. One model [81] is based on a generic approach using a modular design to incorporate several candidates for each type of model. Models categorized as active sonar/reverberation models are summarized in Table 3 together with references to available documentation.

MODEL EVALUATION AND VALIDATION

The large number of available acoustic models complicates the selection of the model most appropriate for specific user needs. The topic of acoustic model evaluation, therefore, is important in any review of acoustic modeling techniques. This subject has been addressed in recent reports [89, 90].

Table 2. Summary of Noise Models

Ambient Noise	Beam-Noise Statistics
DANES [63, 64]	BBN Shipping Noise Model [68-71]
FANM I [65]	DSBN [74, 75]
Normal Mode Ambient Noise Model [66]	USI Array Noise Model [72]
RANDI [67]	Wagner Associates Noise Model [73]

Table 3. Summary of Active Sonar/Reverberation Models

CONGRATS I, II, III, V [76-79]
DOP [80]
Generic Sonar Model [81]
LIRA [82]
LORA [83]
NISSM II [84]
RAIBAC [85]
REVGEN [86]
SONAR [87, 88]

A severe limitation on the degree to which models can be evaluated and validated is the lack of environmental-acoustic data of sufficient spatial and temporal resolution with which to generate and compare model outputs, particularly the range-dependent versions. In the past this situation has encouraged the proliferation of model-to-model comparisons.

A methodology for comparing models against measured data developed by the Panel on Sonar System Models, or POSSM [91, 92], was applied to numerous propagation loss models. Among the many observations made by POSSM was the lack of documentation standards for acoustic models [89].

In an effort to promote standardization, the Navy has recently established the Acoustic Model Evaluation Committee (AMEC). The specific charter of AMEC is to establish a management structure and administrative procedures for the evaluation of acoustic models of propagation loss, noise, and reverberation [90]. Specific evaluation factors to be considered include model accuracy, running time, core storage, complexity of program execution, ease of implementation, ease of effecting slight program alterations, and available ancillary information [89].

CONCLUDING REMARKS

This review has briefly described the characteristics and applications of those acoustic models developed by the Navy sonar modeling community that have been reported in the open literature. Descriptions of other models not reviewed here, together with summaries of data available for model development and operation have been reported elsewhere [93].

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BOOK REVIEWS

HIGH VELOCITY DEFORMATION OF SOLIDS

K. Kawata and J. Shioiri, Editors
Springer-Verlag, Berlin, 1978, $46.10

This book contains the proceedings of the International Union of Theoretical and Applied Mechanics (IUTAM) on High Velocity Deformation of Solids. The meeting was held at the Science Council of Japan, in Tokyo, on August 24-27, 1977.

The intent of the symposium was to cover subjects in theory, experiment, and instrumentation associated with the high-velocity deformation of solids including metals, polymers, and composite materials. Both macro- and micro-mechanics (from continuum to dislocation dynamics) aspects of the subject were addressed. The 33 papers included in this book were presented in nine separate technical sessions. Sessions 1, 2, 3, and 4 covered topics about the micro-mechanical aspects of wave propagation as well as deformation and fracture of metals and composites under dynamic loading.

The problem of the dynamic propagation of a single crack was addressed in session 5. Analytical methods for macro-mechanical modeling of high velocity deformation and fracture (i.e., spalling and cratering) were covered in session 6. Session 7 treated various problems in wave propagation in anisotropic media, combined dynamic stress effects, penetration, ricochet, and both supersonic and transonic impact. High-velocity deformations in structures and structural elements were the topics discussed in sessions 8 and 9.

This book is an excellent general reference for information concerning the high-velocity deformation of solids. Particular insight is given on the role that micro-mechanical processes play in macro-mechanical observations. Most of the papers that make up this book have excellent reference sections. Consequently, the subjects covered in the individual papers can be supplemented with the information available in the various bibliographies to provide a complete and current review of the field of high velocity deformation in solids.

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MASCHINENELEMENTE

K.H. Decker
Gestaltung und Berechnung, 7. Aufl., 396 Seiten, 403 Bilder, 142 Tabellen, Carl Hauser Verlag München, Wien, 1975

The large field of machine elements increases continuously as new results are reported. For teaching purposes only a selected part of the field can be presented. This book corresponds to the curricula at Technical Colleges in Germany. It contains the following chapters: unsolvable connections (62 pp), solvable connections (53 pp), elastic springs (25 pp), axles and shafts (15 pp), bearings (50 pp), seals (6 pp), shaft-couplings (14 pp), belt- and chain-drives (47 pp), and toothed gears (72 pp).

All subjects are dealt with in a descriptive, geometric way with a minimum use of formulas. There are 403 figures and 142 tables. The essence of the construction is clearly demonstrated. Emphasis is given to the correct choice of material and to the calculation of, or at least the estimation of, admissible stresses and loads. The international system of units (SI) is used. For obvious reasons standardized machine elements are referred to the German Standard (DIN).

The book is one within a co-ordinated series on machine-elements, exercises, and mechanics. It has

been written for use at Technical Colleges and has apparently been well received – this is the seventh edition. It deserves attention from both students and practicing engineers.

G. Schweitzer
ETH Zürich
Switzerland

IDENTIFICATION OF VIBRATING SYSTEMS

M. Rades
Rumanian Socialist Republic Academic Press, 1979
(In Rumanian)

This text is a survey of methods used to identify the eigenproperties, mass and stiffness, and nonlinear properties of single and multi-degree-of-freedom systems. It is the only text I have seen that contains much of the practical work in this field. If made available in an English translation it would be a valuable book for anyone in vibration and shock analysis and testing, or in the teaching of these subjects. The writer, a member of the Polytechnic Institute of Bucharest, Strength of Materials laboratory, has had good contact with both Western European, United States, and Eastern European literature. Most of his 141 references are from Western countries and date from 1965 to 1975.

Chapter 1 discusses the nature of free and forced vibration; machine vibration problems; and structural testing, modeling, and model validation by comparison to experimental data. Direct and inverse problems are discussed (response prediction, model identification, force identification). The degree of modeling sophistication, data adequacy, and goals of a combined analysis and test program are related. These points are well handled on a philosophical level and are followed by a good, brief literature review.

Chapter 2 deals with linear single-degree-of-freedom systems. The various identification methods are separately and exhaustively presented for both viscous and structural damping. Methods include the bandwidth method, polar diagrams, and various peak and peak amplitude ratio algorithms. All use sinusoidal sweeps or single frequency sinusoids. Applied force and base excitation are covered, including eccentric mass vibrators. The additional mass method, complex power supplied, sudden sine start, and transient decay methods are also briefly presented.

Chapter 3 deals with multiple-degree-of-freedom systems. A short review of modal analysis, diagonal and non-diagonal damping, real and complex modes, and the state space formulation is followed by application of results of the previous chapter on a mode by mode basis.

Chapter 4 is the most difficult for any book on systems identification in that it tries to review the many different approaches and principles of identification of mechanical systems. The author does a fair job. Technology trees for time vs frequency domain are used. The following are explained: direct (single step) vs indirect (iterative) methods, modal vs physical (i.e., K.M.) models, and complete vs incomplete models (that is, the number of experimental modes is equal to or less than the number of model modes). A few methods are briefly reviewed, and many others are not discussed at all. Reduced models, relations between eigenparameters (ω, ϕ, W) and model parameters (M, K), and the use of pseudo inverse are presented briefly.

Chapters 5 and 6 discuss single- and multi-point excitation of modal linear systems with viscous and structured damping, including simple graphical methods for systems with up to three degrees of freedom. Most methods are direct and single step in the polar plane. Some least-mean-square techniques, including the work of Klosterman, are presented. Excitation of pure modes (methods of Dat and of Asher) is reviewed. The theoretical basis of work of Kennedy and Pancu, Lewis and Wrisley, Traill and Nash, and others is presented. Chapter 7 presents a good, brief review of the little that has been done with nonlinear systems (only for single degree of freedom).

Of course one could wish for additional material. For example, no information is given of stand alone computers, modal analysis hardware, spectrum analyzers, or computer software. This probably reflects the lack of availability of such items in the Eastern European countries. There is no applications data, nor is there a discussion of errors or the practicability

of using each method with real data. A second test (Vibration Measurement, G. Buzdugan, E. Mihaileson, G. Rades, 1979) covers the practical side of testing and instrumentations and presents some data, but little systems identification.

Nevertheless, Rades work is valuable in that it is the only one that has come to my attention in which the author has attempted a broad coverage of the practical aspects of identification theory as it is applied to mechanical testing; in addition, it is suitable as an introductory text or for teaching.

Books such as this one by Rades are necessary if the sophisticated theory and techniques for systems identification are to be regularly applied to a wide variety of structures and not just to expensive one-of-a-kind aerospace vehicles. A broad understanding of the technology – for practicing engineers and students – must be coupled with the availability of standardized and validated software before such application will be possible and rewarding.

P. Ibáñez
ANCO Engineers, Inc.
Santa Monica, California

SHORT COURSES

FEBRUARY

VIBRATION AND SHOCK SURVIVABILITY, TESTING, MEASUREMENT, ANALYSIS, AND CALIBRATION

Dates: February 2-6, 1981
Place: Santa Barbara, California
Dates: March 2-6, 1981
Place: Washington, D.C.
Dates: April 6-10, 1981
Place: Boston, Massachusetts
Dates: May 18-22, 1981
Place: Syosset, New York
Dates: August 24-28, 1981
Place: Santa Barbara, California
Dates: October 5-9, 1981
Place: Bournemouth, England

Objective: Topics to be covered are resonance and fragility phenomena, and environmental vibration and shock measurement and analysis; also vibration and shock environmental testing to prove survivability. This course will concentrate upon equipments and techniques, rather than upon mathematics and theory.

Contact: Wayne Tustin, 22 East Los Olivos St., Santa Barbara, CA 93105 - (815) 682-7171.

MACHINERY DATA ACQUISITION

Dates: February 2-6, 1981
June 1-5, 1981
August 3-7, 1981
September 28 - October 2, 1981
December 7-11, 1981
Place: Carson City, Nevada

Objective: This seminar is designed for people whose function is to acquire machinery data for dynamic analysis, using specialized instrumentation, and/or that person responsible for interpreting and analyzing the data for the purpose of corrective action on machines. Topics include measurement and analysis parameters, basic instrumentation review, data collection and reduction techniques, fundamental rotor behavior, explanation and symptoms of common machinery malfunctions, including demonstrations and case histories. The week also includes a lab workshop day with hands-on operation of the instrumentation and demonstration units by the participants.

Contact: Kathy Fredekind, Bently-Nevada Corporation, P.O. Box 157, Minden, Nevada 89423 - (702) 782-3611, Extension 224.

INTRODUCTION TO GIFTS 5 - USER WORKSHOP

Dates: February 9-13, 1981
Place: Tucson, Arizona

Objective: It is expected that the user is familiar with the fundamentals of the finite element method and intends to use the GIFTS program as a pre- and post-processor or as an analysis package. Apart from lectures dealing with the theoretical and numerical aspects, ample time will be devoted to gaining experience with GIFTS by solving a number of selected examples and user projects.

Contact: Dr. Hussein A. Kamel, Professor of Aerospace and Mechanical Engineering, The University of Arizona, College of Engineering, Tucson, AZ 85721 - (602) 626-1650/626-3054.

ROTOR DYNAMICS ENGINEERING

Dates: February 16-18, 1981
Place: Daytona Beach, Florida

Objective: This intensive course has been especially designed for specialists, engineers, and scientists working in industrial and governmental facilities involved with rotor dynamics. This course provides participants with an understanding of the principles of rotor dynamics and the application of these principles to practical problems in rotor dynamics engineering.

Contact: Union College, Office of Graduate Studies, 1 Union Avenue, Schenectady, NY 12308 - (518) 370-6288.

APPLIED VIBRATION ENGINEERING

Dates: February 16-18, 1981

Place: Daytona Beach, Florida

Objective: This intensive course is designed for specialists, engineers and scientists working in industrial, governmental and educational institutions involved with design against vibration or solving of existing vibration problems. This course provides participants with an understanding of the principles of vibration and the application of these principles to practical problems of vibration reduction.

Contact: Union College, Office of Graduate Studies, 1 Union Avenue, Schenectady, NY 12308 - (518) 370-6288.

BASIC INSTRUMENTATION SEMINAR

Dates: February 24-25, 1981

Place: Tampa, Florida

Dates: March 3-5, 1981

Place: Houston, Texas

Dates: April 21-23, 1981

Place: Chicago, Illinois

Dates: April 28-30, 1981

Place: Buffalo, New York

Dates: May 5-7, 1981

Place: Edmonton, Alberta

Dates: September 15-17, 1981

Place: New Orleans, Louisiana

Dates: October 20-22, 1981

Place: Houston, Texas

Dates: October 27-29, 1981

Place: Pittsburgh, Pennsylvania

Objective: This course is designed for maintenance technicians, instrument engineers, and operations personnel - those individuals responsible for installation and proper operation of continuous monitoring systems. An in-depth examination of probe installation techniques and monitoring systems including types, functions, and calibration procedures is provided. Also presented is an overview of some of the instrumentation used to acquire data for vibration analysis, including oscilloscopes, cameras, and specialized filter instruments.

Contact: Kathy Fredekind, Bently-Nevada Corporation, P.O. Box 157, Minden, Nevada 89423 - (702) 782-3611, Extension 224.

MARCH

ADVANCED GIFTS 5 USER WORKSHOP AND GIFTS 5 SYSTEMS WORKSHOP

Dates: March 9-13, 1981

Place: Tucson, Arizona

Objective: Two parallel sessions are planned, an advanced user workshop (AW), intended for users already familiar with GIFTS, and a systems workshop (SW), aimed at the programmer who intends to modify, implement or add to the system. The last day of the week will be devoted to a GIFTS Users Group Meeting in which GUG members may present papers and interact on various issues.

Contact: Dr. Hussein A. Kamel, Professor in Aerospace and Mechanical Engineering, College of Engineering, University of Arizona, Tucson, AZ 85721 - (602) 626-1650/626-3054.

MEASUREMENT SYSTEMS ENGINEERING

Dates: March 9-13, 1981

Place: Phoenix, Arizona

MEASUREMENT SYSTEMS DYNAMICS

Dates: March 16-20, 1981

Place: Phoenix, Arizona

Objective: Program emphasis is on how to increase productivity, cost-effectiveness and data-validity of data acquisition groups in the field and in the laboratory. Emphasis is also on electrical measurements of mechanical and thermal quantities.

Contact: Peter K. Stein, 5602 East Monte Rosa, Phoenix, AZ 85018 - (602) 945-4603/946-7333.

MECHANICAL ENGINEERING

Dates: March 30 - April 3, 1981
August 31 - September 4, 1981

Place: Carson City, Nevada

Objective: This course is designed for the mechanical or maintenance engineer who has responsibility for the proper operation and analysis of rotating machinery. Working knowledge of transducers, data acquisition instrumentation and fundamental rotor behavior is a prerequisite. The course includes: a guest speaker in the field of machinery malfunctions; descriptions and demonstrations of machinery malfunctions; discussions of the classification, identification, and correction of various machine malfunc-

tions; a one day rotor dynamics lab with individual instruction and operation of demonstration units; and emphasis on the practical solution of machinery problems rather than rotor dynamic theory.

Contact: Kathy Fredekind, Bently-Nevada Corporation, P.O. Box 157, Minden, Nevada 89423 - (702) 782-3611, Extension 224.

APRIL

CORRELATION AND COHERENCE ANALYSIS FOR ACOUSTICS AND VIBRATION PROBLEMS

Dates: April 6-10, 1981

Place: Los Angeles, California

Objective: This course covers the latest practical techniques of correlation and coherence analysis (ordinary, multiple, partial) for solving acoustics and vibration problems in physical systems. Procedures currently being applied to data collected from single, multiple and distributed input/output systems are explained to classify data and systems, measure propagation times, identify source contributions, evaluate and monitor system properties, predict output responses and noise conditions, determine nonlinear and non-stationary effects, and conduct dynamics test programs.

Contact: Department of Engineering and Mathematics, UCLA Extension, P.O. Box 24901, Los Angeles, CA 90024 - (213) 825-4100.

JULY

INSURANCE INDUSTRY SEMINAR

Dates: July 7-9, 1981

Place: Carson City, Nevada

Objective: This course is designed for personnel from the insurance industry or self-insured companies who are responsible for inspection of plants that use large, high-speed rotating machinery. Features in the seminar include: discussion of the economics of machine monitoring and predictive maintenance; presentation of machine types that should be considered, and minimum standards necessary for effective machine protection diagnosis; information and the presentation of catastrophic failure by use of proper maintenance methods and malfunction diagnosis techniques; and survey of state-of-the-art methodology.

Contact: Kathy Fredekind, Bently-Nevada Corporation, P.O. Box 157, Minden, Nevada 89423 - (702) 782-3611, Extension 224.

NEWS BRIEFS: news on current and Future Shock and Vibration activities and events

OPTIMUM STRUCTURAL DESIGN SYMPOSIUM

Announcement & Call For Papers

An International Symposium on Optimum Structural Design will be held October 19-22, 1981 at the University of Arizona in Tucson under sponsorship of the U.S. Office of Naval Research (ONR) and the College of Engineering, University of Arizona. In view of ONR interest and affiliation, the meeting will be the eleventh in the series of Naval Structural Mechanics Symposia. This distinguished series has, in the past, focused on such topics as plasticity, fracture mechanics, and aircraft crashworthiness. The topic of structural optimization is being addressed for the first time in the series in the planned Symposium.

The program is intended to have broad coverage in the general area of structural optimization, with sessions on such topics as optimality criteria methods, mathematical programming approaches, optimal control theory, special methods of optimization, practical applications and computer software, and interactive graphics in the structural design process.

Abstracts of papers (300 words) should be submitted to the Symposium Organizing Committee by April 1, 1981. Authors of selected papers will be notified by May 31, 1981. Completed manuscripts, on author-prepared mats, will be due by August 1, 1981.

For further information, contact: Dr. Erdal Atrek, Dept. of Civil Engineering, Building No. 72, University of Arizona, Tucson, Arizona 85721.

APPLIED MODELLING AND SIMULATION CONFERENCE

The First International Conference and Exhibition on Applied Modelling and Simulation will be held on September 7-11, 1981 in Lyon, France. The Conference is organized by the I.A.S.T.E.D. (International Association of Science and Technology for Development) and the A.M.S.E. (Association for the Advancement of Modelling and Simulation Techniques in Enterprises).

Modelling (the schematic description of systems and devices) and simulation (the ue of models to investigate or optimize processes, without necessarily experimenting on the real system) are usable in all technical or nontechnical activities.

The subjects treated will include general methods of modelling and simulation as well as their applications in the following fields: materials, mechanics and civil engineering, thermoanalysis, energetics, geology and resources, biology, medicine and pharmacy, education, sociology, economy, transports, etc.

The conference and exhibition do not only consist of specialized and elaborate developments but also of initiating and synthetizing conferences. On that account, they appeal to both specialists in modelling and simulation and those who want to learn these techniques.

For further information, contact: A.M.S.E., 16, Avenue de Grande Blanche, 69160 TASSIN-LA-DEMI-LUNE, France

INTERNATIONAL CONGRESS ON RECENT DEVELOPMENTS IN ACOUSTIC INTENSITY MEASUREMENT

An International Congress on Recent Developments in Acoustic Intensity Measurement will be held September 30 - October 2, 1981 in Senlis, France.

In all conventional measurement techniques energy flow is inferred from pressure (as to contrast with intensity) but the advent of new techniques now

allows the direct measurement of energy flux. The principle of acoustic intensity measurement has been known since half a century but realization of practical instruments has taken place significantly only in the last decade because of recent innovation in electronics. The application of these techniques includes sound power calculation, source localization, transmission loss determination, etc. The aim of this congress is to stimulate the exchange of ideas among research workers as well as to give information to potential users.

The topics to be covered include:

- Fundamental aspects: General conceptions of energy transfers, measurement principle, inherent errors
- Present state of the art of instrumentation: Transducer association, signal processing (digital and analog), in situ measurement devices, calibration techniques
- Application to the characterization of sound sources: Sound radiation from mechanical and building structures, localization, sound absorption
- Sound power determination in industrial environments: Near field measurement techniques, environmental influences, error analysis, comparison with classical methods, case histories
- Energy propagation in structures and fluids: Energy flux in rods, plates, ducts, pipes . . . specific measurement techniques
- Outlook: Technical evolution, standards for noise measurement
- Exhibition and demonstration of various devices

For further information, contact: Professor M. Crocker, Ray W. Herrick Laboratories, School of Mechanical Engineering, Purdue University, West Lafayette, IN 47907.

SPECIALISTS MEETING ON DYNAMIC ENVIRONMENTAL QUALIFICATION TECHNIQUES

The following is an outline of the final program of the Specialists Meeting on "Dynamic Environmental Qualification Techniques" featured at the 53rd Meeting of the AGARD Structures and Materials Panel. The meeting is to be held September 28-30, 1981 in Noordwijkerhout, The Netherlands. Meeting Chairman is H. Försching.

SESSION I – OVERVIEWS

September 28, 1981 9:00 - 12:00
Chairman: H. Försching - GE

Introduction
H. Försching - GE

Development and Use of Dynamic Qualification Standards for Air Force Stores
A. Burkhard and O. Mauer - Air Force Wright Aeronautical Laboratories and W. Frost - Aeronautical Systems Division, Wright Patterson Air Force Base, OH, US

Problems in the Ground Simulation of the Dynamic Responses Induced in Externally Carried Stores During Flight
J. Homfray - Cape Engineering, UK

Progrès dans l'éboration des programmes d'essais d'environment mécanique
M. Coquelet - CEAT, Toulouse, France

Qualification of Equipment for Gunfire Induced Vibration
A. Peacock - British Aerospace, Warton, UK

SESSION II – APPLICATIONS

September 28, 1981 14:00 - 17:00
Chairman: C.G. Lodge - UK
Recorder: R.H. Volin - US

Dynamic Qualification Testing of F-16 Equipment
W.J. Brignac - General Dynamics, US

Development of Vibration Qualification Test Spectra for the F-15 Aircraft
G.R. Wayman - McDonnell Douglas, US

Equipment Vibration Qualification for Harrier and Hawk Aircraft
D.C. Thorby - British Aerospace, Kingston, UK

Acoustic Noise Test as Part of the Dynamic Qualification Program in Aerospace
G. Baierdörfer - IABG, Ottobrunn, Germany

SESSION III – APPLICATIONS

September 29, 1981 **9:00 - 12:00**
Chairman: G. Haidl - GE
Recorder: R.H. Volin - US

Dynamic Environment Induced by a Pylon-Mounted, Lightweight, 30 mm Gun Pod
T.D. Arthurs and J.W. Lile - Northrop Corp., US

Vibration Qualification of External A/C Stores and Equipment
G. Haidl, M. Steininger - MBB, Ottobrunn, Germany

Aircraft Fuel Tank Slosh and Vibration Test
W. Rasch - IABG, Ottobrunn, and H. Zimmermann - VFW, Bremen, Germany

Definition and Assessment of the Dynamic Loads Induced During Flight Carriage
A.R. Mableson - Hunting Engineering, Ltd., UK

SESSION IV – HELICOPTER

September 29, 1981 **14:00 - 16:00**
Chairman: R. Wolfe - US

The Structural and Dynamic Interface Required for Developing Helicopter Target Acquisition Systems
S.T. Crews - US Army AVRADCOM, US

Approach in Dynamic Qualification of Light Helicopter Stores and Equipments
D. Braun and J. Stoppel - MBB, Ottobrunn, Germany

The Dynamic Qualification of Equipment and External Stores for Use with Rotary-Winged Aircraft
J. Bartovsky - Westland Helicopters, Ltd., UK

SESSION V – DEVELOPMENT

September 29, 1981 **16:00 - 17:40**
Chairman: H.A. Magrath - US
Recorder: D. Underhill - US

Application of Modal Synthesis Techniques for the Dynamic Qualification of Wings with Stores
E. Breitbach - DFVLR - Institut für Aeroelastik, Göttingen, Germany

STOL Aircraft Structural Vibration Prediction from Acoustic Excitation
B. Dotson - Boeing Co., US

SESSION V (cont.) – DEVELOPMENT

September 30, 1981 **9:00 - 10:30**
Chairman: H.A. Magrath - US
Recorder: D. Underhill - US

Gunfire Blast Pressure Predictions
R. Munt - RAE Aero., UK

Development of a Taped Random Vibration Technique for Acceptance Testing
E.F. Baird - Grumman, US

SESSION VI – ROUND TABLE DISCUSSION

September 30, 1981 **11:00 - 12:30**
Chairman: H. Försching - GE

Attendance at this meeting is by invitation only and is normally restricted to citizens of NATO nations. US citizens who wish to attend this meeting should contact:

Dr. James J. Olsen
Structures and Dynamics Division
Air Force Wright Aeronautical Laboratories/FIB
Wright Patterson Air Force Base, OH 45433

Citizens of other NATO nations should contact the appropriate enrollment coordinator listed below.

Canada
Mr. J.C. Baril
AGARD Liaison Officer
National Defence Headquarters
CRAD/DESA-3
101 Colonel By Drive
Ottawa, Ontario K1A 0K2

Germany
Dipl.-Ing. H. Zocher
IAB GmbH - Abt TF
Einsteinstrasse 20
D-8012 Ottobrunn

Italy

Ufficio del Delegato Nazionale
all' AGARD
Aeronautica Militare
3 Piazzale Adenauer
00144 ROMA/EUR

Netherlands

Nederlandse Delegatie bij de AGARD
p/a Stichting NLR
Postbus 126
2600 AC DELFT

Other Nations

Executive, SMP
AGARD-OTAN
7, rue Ancelle
92200 Neuilly-Sur-Seine
France

ABSTRACTS FROM THE CURRENT LITERATURE

Copies of articles abstracted in the DIGEST are not available from the SVIC or the Vibration Institute (except those generated by either organization). Inquiries should be directed to library resources. Government reports can be obtained from the National Technical Information Service, Springfield, VA 22151, by citing the AD-, PB-, or N- number. Doctoral dissertations are available from University Microfilms (UM), 313 N. Fir St., Ann Arbor, MI; U.S. Patents from the Commissioner of Patents, Washington, D.C. 20231. Addresses following the authors' names in the citation refer only to the first author. The list of periodicals scanned by this journal is printed in issues 1, 6, and 12.

ABSTRACT CONTENTS

MECHANICAL SYSTEMS

ROTATING MACHINES

(Also see Nos. 301, 313, 315, 324, 445, 475)

81-218

Mathematical Model and the Dynamic Simulation of an Electromechanical Rotary Device

J.D. Emergy

Bendix Corp., Kansas City, MO, Rept. No. BDX-613-2376, 65 pp (Feb 1980)

N80-25667

Key Words: Rotating structures, Computer programs

A mathematical model of an electromechanical rotary device is presented. This device contains a rotor, stator, and two springloaded arms which restrict the rotor motion. The desired action is the alignment of the rotor and the consequent movement of the arms. The SLENOID computer program for calculating the magnetic torque, air gap permeance, spring torque, damping effects, and motion of the rotor and arms is described.

81-219

Instability of Motion of a Disc Supported by an Asymmetric Shaft in Asymmetric Bearings (Influence of External Damping)

T. Kotera and S. Yano

Faculty of Engrg., Kobe Univ., Bull. JSME, 23 (181), pp 1194-1199 (July 1980) 11 figs, 1 ref

Key Words: Rotor-bearing systems, Shafts (machine elements), Free vibration, Damping effects

A new method for determining regions of instability of free vibrations of a rotor supported by an asymmetric massless flexible shaft in asymmetric massless bearings with external damping is presented. A general solution to equations of motion is described in exponential and sinusoidal form.

81-220

General Calculations of Turbomachinery Rotor and Foundation Vibrations

K. Kramer

VDI-Berichte, 381, pp 121-127 (1980) 13 figs (In German)

Key Words: Rotor-bearing systems, Turbomachinery, Vibration response, Foundations

A method for the determination of the effect of foundation on the vibration of turbomachinery is presented, based on the determination of kinetic stiffness of bearings.

81-221

On Nonconservative Gyroscopic Eigenvalue Problems in Elasticity

J. Padovan and M. Adams

Univ. of Akron, Akron, OH 44325, Intl. J. Engr. Sci., 18 (11), pp 1333-1348 (1980) 3 figs, 10 refs

Key Words: Rotating structures, Eigenvalue problems

The influence of nonconservatism on the dynamics of rotating systems modeled by 3-D elasticity is considered. The fields are treated as small dynamic excursions about a potentially large initial state. Particular emphasis is given to determining the various properties of the associated eigenvalue/function problem. A specialized first order form is introduced which enables the development of a multiply connected biorthogonality principle. Results are specialized to eigenvalue/vector problems arising from finite-element/difference simulations of nonconservative systems.

81-222

The Response of Turbine Engine Rotors to Interference Rubs

A.F. Kascak

NASA Lewis Res. Ctr., Cleveland, OH, Rept. No. NASA-TM-81518 (Presented at Army Sci. Conf., West Point, NY June 17-19, 1980), 18 pp (1980)

N80-27696

Key Words: Rotors (machine elements), Blade loss dynamics, Turbine engines

A method was developed for the direct integration of a rotor dynamics system experiencing a blade loss induced rotor rub. Both blade loss and rotor rub were simulated on a rotor typical of a small gas turbine. A small change in the coefficient of friction caused the rotor to change from forward to backward whirl and to theoretically destroy itself in a few rotations. This method provides an analytical capability to study the susceptibility of rotors to rub induced backward whirl problems.

81-223
Polar Plots Using UVA Rotor. Final Report
S.L. Hendricks
Virginia Polytechnic Inst. and State Univ., Blacksburg, VA, 14 pp (Dec 1979)
UVA-ER-515-79U

Key Words: Rotors (machine elements), Flexible rotors, Natural frequencies, Mode shapes, Damping coefficients, Mathematical models

The rotor model is designed to find vibration frequencies, damping factors, and mode shapes for a flexible rotor which includes a top and bottom suspension system. The UVA Rotor does not incorporate the effects of imbalance. Alterations necessary to include an imbalance weight in the formulation of the UVA Rotor so that the code can be used to generate polar plots for experimental comparison are described.

81-224
Disc Vibration - Rotating Blade and Stationary Vane Interaction
F. Kushner
Vibrations/Acoustics, Elliott Co., Div. of Carrier Corp., Jeannette, PA 15644, J. Mech. Des., Trans. ASME, 102 (3), pp 579-584 (July 1980) 11 figs, 2 tables, 10 refs

Key Words: Disks (shapes), Blades, Fatigue life, Rotating structures

The vibration of a bladed disc assembly is investigated for possible fatigue failures due to disc modes. Methods that can be used to prevent failures are outlined. Two types of bladed discs are treated: centrifugal applications with radial blades and those used for axial turbines or compressors. Analysis is presented showing cases of significant minor resonences over and above disc critical speeds.

81-225
On Damped Coupled Torsional and Flexural Vibrations of Gear-Connected Parallel Shafts
F. Buckens
Univ. of Louvain-La-Neuve, Belgium, ASME Paper No. 80-C2/DET-6

Key Words: Shafts (machine elements), Couplings, Gear couplings, Torsional vibration, Flexural vibration

Time variations of distances between the centers of gears in contact induce variations in the transmission ratio, which cause coupling between flexural and torsional vibrations of the shafts which carry them. Since this connection is nonholonomous, the analysis by Lagrangian equations can be carried out when Ferrer's multiplier is introduced in order to take into account the corresponding non-integrable nonworking constraint. It is then easy to include the damping due to friction at the contact between the gear teeth.

81-226
Discrete Frequency Noise Due to Irregularity in Blade Row of Axial Fan Rotor
T. Fukano, Y. Kodama, and Y. Takamatsu
Faculty of Engrg. 36, Kyushu Univ., Fukuoka, Japan, Bull. JSME, 23 (182), pp 1335-1343 (Aug 1980) 13 figs, 3 tables, 12 refs

Key Words: Fans, Fan blades, Noise generation

Discrete tones appear in the frequency band lower than the blade passing frequency, when a rotor has manufacturing errors of stagger angle, pitch, camber or chord length, which is at variance with the theory that the frequency of discrete noise corresponds to the blade passing frequency and its harmonics. The relations between the magnitude of the deviation of the blading parameter from a design value and the induced sound pressure level of discrete tone and the resulted change of fluid dynamic characteristics of the fan are examined.

81-227
Combined Effects of Periodic and Stochastic Loads on the Fatigue of Wind Turbine Parts, Part 6
A. Raab
Structures Dept., Aeronautical Res. Inst. of Sweden, Stockholm, Sweden, Rept. No. FFA-AU-1499-Pt-6, 60 pp (Oct 1979)
N80-28732

Key Words: Wind turbines, Fatigue life, Periodic excitation, Stochastic processes

Selected topics on simulation of turbulence and fatigue evaluation of wind turbines are presented. The importance of correct application of random loads and the mathematical description of nonstationary processes are discussed. The two point cross spectra of turbulence, with regard to shear flow in the boundary layer of the earth and to the inclination of wind gusts, is determined.

RECIPROCATING MACHINES

81-228

Primary Noise Abatement on Centrifugal Pumps

D. Florjancic, W. Schoffler, and H. Zogg

Sulzer Weise GbmH, Bruchsal, Sulzer Technical Review, 62 (1), pp 24-26 (1980) 2 figs

Key Words: Pumps, Centrifugal pumps, Noise reduction

Investigations into the reduction of the sound pressure level on centrifugal pumps are reported. Primary noise abatement is believed to be possible without significantly increasing the production and operating costs.

81-229

Investigation of Several Influences on the Dynamic Performance of Medium-Speed Marine Diesel Engines, Part 1: Calculation Model (Untersuchung einzelner Einflüsse auf das instationäre Betriebsverhalten mittelschnellaufender Schiffsdieselmotoren, Teil 1: Berechnungsverfahren)

P. Boy

Am Stockener Bach 7A, D-3000 Hannover 21, MTZ Motortech. Z., 41 (9), pp 343-348 (Sept 1980) 8 figs, 18 refs

Key Words: Marine engines, Diesel engines, Dynamic response, Mathematical models

The poor dynamic response of medium-speed Diesel engines with increasing turbocharging partially leads to an evident deterioration of the maneuverability of marine propulsion engines. Influence of different factors on the dynamic response of turbocharged engines and the remedial measures for acceleration and maneuvering capability is investigated.

POWER TRANSMISSION SYSTEMS

81-230

Mathematical Modelling and Nonlinear Dynamics of a Class of Homokinetic Systems

N. Bellomo and A.P. Orsi

Inst. of Meccanica Razionale and Inst. of Matematica, Corso Duca degli Abruzzi 24, 10125 Torino, Italy, Mech. Mach. Theory, 15 (5), pp 371-383 (1980) 5 figs, 2 tables, 15 refs

Key Words: Power transmission systems, Nonlinear analysis (theories)

The dynamics of a particular transmission system constituted by two sliding and rotating elements connected by a constant velocity joint is analyzed. A mathematical model is proposed for the simulation of the system and the dynamics of the system is studied on the basis of the model.

METAL WORKING AND FORMING

(Also see No. 319)

81-231

"Chatter-Proof" Overhang Boring Bars – Stability Criteria and Design Procedure for a New Type of Damped Boring Bar

R.W. New and Y.H.J. Au

Brunel Univ., Uxbridge, Middlesex, UK, J. Mech. Des., Trans. ASME, 102 (3), pp 611-618 (July 1980) 11 figs, 5 refs

Key Words: Machine tools, Chatter, Vibration damping

Vibration problems encountered when using overhung boring bars to profile bore high duty alloy workpieces is reviewed. It is shown how dynamic instability can be successfully represented by a self-induction term and incorporated in the equations of motion for an analog of a boring bar. New information of the mechanism of operation of a Lanchester damper is reported.

81-232

Modern Methods for Calculation of the Static and Dynamic Performance of Machine Tools (Moderne Verfahren zur Berechnung des statischen und dynamischen Verhaltens von Werkzeugmaschinen)

H. Pilz, R. Nollau, C.Wolf, and O. Wasner

Forschungszentrum des Werkzeugmaschinenbaus Karl-Marx-Stadt, Maschinenbautechnik, 29 (3), pp 128-132 (1980) 10 figs, 10 refs

(In German)

Key Words: Machine tools, Computer programs, Optimization, Chatter

Several computer programs based on finite element technique for the calculation of the dynamic properties of machine tools are described, as well as methods for the modeling and the determination of chatter limits.

ELECTROMECHANICAL SYSTEMS

(Also see No. 213)

81-233

Dynamic Testing of the Roadway Powered Electric Vehicle (RPEV) System

D.D. Davis, C.W. Dease, R.I. Wallace, and C.E. Walter

Lawrence Livermore Lab., California Univ., Livermore, CA, Rept. No. CONF-800523-2, 17 pp (Feb 27, 1980)

UCRL-83662

Key Words: Electric vehicles, Dynamic tests, Test facilities

Practicality of the Roadway Powered Electric Vehicle (RPEV) System under dynamic operating conditions is examined. Descriptions of the dynamic test facility, the status of RPEV component and test system development, dynamic test plans, and results of the static prototype tests previously conducted are presented.

MATERIALS HANDLING EQUIPMENT

81-234

An Experimental Investigation of the Vibration of Toothed Belts

J.N. Fawcett and J.S. Burdess

Univ. of Newcastle Upon Tyne, UK, ASME Paper No. 80-C2/DET-94

Key Words: Belts (moving), Natural frequencies

Values of natural frequencies for a stationary belt calculated using simple theory are compared with experimentally measured frequency response curves. The typical non-linear behavior observed experimentally shows that the simple theory is inadequate for predicting the dynamic behavior of the belt.

81-235

The Effect of Play and Elasticity on the Transfer Function of Connecting Mechanisms of a Warp Knitting Loom (Einfluss von Spiel und Elastizität auf die Übertragungsfunktion der Koppelgetriebe einer Kettenwirkmaschine)

M. Hertzsch

VEB Wirkmaschinenbau Limbach-Oberfrohna, East Germany, Maschinenbautechnik, 29 (4), pp 182-186 (1980) 8 figs, 11 refs

Key Words: Textile looms, Stiffness

Experimental investigations and the results obtained by means of the PS KOGEOP computer program show that the play and elasticity of linkages of the drives of a warp knitting loom have a pronounced effect on its performance. Reduction of play and an increase in the stiffness of the linkages, especially at the support points, increases its performance and provides a basis for further dynamic analysis of the system.

STRUCTURAL SYSTEMS

BRIDGES

81-236

Fatigue of Curved Steel Bridge Elements: Fatigue Tests of Curved Box Girders

J.H. Daniels and R.P. Batcheler

Fritz Engrg. Lab., Lehigh Univ., Bethlehem, PA, Rept. No. FEL-398.4, FHWA-RD-79-134, 136 pp (Apr 1980)

PB80-187511

Key Words: Bridges, Girders, Box beams, Fatigue tests, Steel

Eight types of welded details were selected for placement on three full-scale curved steel box girders. The fatigue behavior of the welded details was monitored while subjecting the box girders to approximately two million constant amplitude load cycles. Primary fatigue crack growth due to the longitudinal normal stress ranges caused by bending and warping torsion was observed. Secondary fatigue crack growth was also observed.

81-237

Fatigue of Curved Steel Bridge Elements: Fatigue Tests of Curved Plate Girder Assemblies

J.H. Daniels and W.C. Herbein

Fritz Engrg. Lab., Lehigh Univ., Bethlehem, PA, Rept. No. FEL-398.3, FHWA-RD-79-133, 154 pp (Apr 1980)

PB80-187503

Key Words: Bridges, Plates, Girders, Fatigue tests, Steel

Research on the fatigue behavior of horizontally curved, steel bridge elements was conducted. The investigation was centered on the effect of welded details on curved girder fatigue strength. Fatigue tests of five full-scale curved plate girder assemblies are reported.

81-238

Fatigue of Curved Steel Bridge Elements: Stress Concentration, Stress Range Gradient, and Principal Stress Effects on Fatigue Life

N. Zettlemoyer, J.W. Fisher, and J.H. Daniels

Fritz Engrg. Lab., Lehigh Univ., Bethlehem, PA, Rept. No. FEL-398.2, FHWA-RD-79-132, 94 pp (Apr 1980)

PB80-187495

Key Words: Bridges, Steel, Fatigue life

Research on the fatigue behavior of horizontally curved, steel bridge elements is conducted. Among the various tasks of this project is the analytical prediction of fatigue life. Within the prediction process is the consideration of stress range gradient across the girder flanges. Attention is directed to the effect of principal stress in a flange as compared to normal stress due to bending and warping.

BUILDINGS

81-239

Seismic Safety Margins Research Program (Phase 1). Project IV. Structural Building Response; Structural Building Response Review

J.J. Healey, S.T. Wu, and M. Murga

Ebasco Services, Inc., NY, 181 pp (Feb 1980)

UCRL-15185

Key Words: Buildings, Seismic response, Nuclear power plants

Current methods and data pertaining to seismic response calculations are reviewed and summarized. This material forms one component in the development of the overall computational methodology involving state of the art computations including explicit consideration of uncertainty and aimed at ultimately deriving estimates of the probability of radioactive releases due to seismic effects on nuclear power plant facilities.

81-240

On Seismic Resistant Design of Steel Diagonal Bracings

L. Chaiyung and T. Weiming

First Ministry of Machine Bldg., Beijing, Peoples Republic of China, ASME Paper No. 80-C2/PVP-83

Key Words: Braces, Buildings, Towers, Seismic design

This paper suggests that two types of steel diagonal bracing may be incorporated into the seismic resistant design of various vessel supports and framed towers. The interior moment resisting frame, due to the high ductility of mild steel, can be utilized to absorb vibrational energy during severe earthquakes. A practical computational method is derived and the restoring force characteristics of such diagonal bracing are presented.

81-241

Reducing Building Failures During Earthquakes

H.J. Degenkolb

H.J. Degenkolb & Assoc., San Francisco, CA, Civ. Engr., NY, pp 56-59 (Aug 1980) 2 figs

Key Words: Buildings, Seismic design

Common building design and structural errors that result in unnecessary building failures during earthquakes are investigated.

81-242

Mutual Pounding of Adjacent Structures During Earthquakes

J.P. Wolf and P.E. Skrikerud

Electrowatt Engrg. Services Ltd., CH-8022 Zürich, Switzerland, Nucl. Engr. Des., 57 (2), pp 253-275 (May 1980) 31 figs, 3 tables, 17 refs

Key Words: Buildings, Nuclear power plants, Seismic excitation, Earthquake response

The seismic response of a structure which, in addition to earthquake loading, is subjected to the impact force resulting from pounding by an adjacent building, is determined. Simple models are used to examine the characteristics of the pounding phenomenon and parametric studies, varying the structural parameters, are performed both for steady-state and transient excitations.

81-243

Method for the Estimation of the Probability of Damage Due to Earthquakes

M.A.H.G. Alderson

Safety and Reliability Directorate Culcheth, UKAEA Risley Nuclear Power Development Establishment, Culcheth, UK, 40 pp (July 1979)

SRD-R-135

Key Words: Buildings, Earthquake damage, Damage prediction, Probability theory, Pipelines, Equipment response

Available information on seismicity within the United Kingdom is combined with building damage data from the United States to produce a method of estimating the probability of damage to structures due to the occurrence of earthquakes. The analysis is based on the use of site intensity as the major damage producing parameter. Data for structural, pipework and equipment items are assumed and the overall probability of damage calculated as a function of the design level.

81-244

Frequency Domain Identification of Structural Models from Earthquake Records

G.H. McVerry

Earthquake Engrg. Res. Lab., California Inst. of Tech., Pasadena, CA, Rept. No. EERL-79-02, NSF/RA-790437, 224 pp (Oct 1979)

PB80-194301

Key Words: Buildings, Earthquake response, Parameter identification technique, Frequency domain method

The usefulness of simple linear mathematical models for representing the behavior of tall buildings during earthquake response is investigated for a variety of structures over a range of motions including the onset of structural damage. The linear models which best reproduce the measured response of the structures are determined from the recorded earthquake motions. A method is developed to identify a single linear model appropriate for the entire response, or to approximate the nonlinear behavior exhibited by structures with a series of models optimal for different segments of the response.

81-245

Noise Control in Music Teaching Facilities

D.L. Klepper, W.J. Cavanaugh, and L.G. Marshall

Klepper Marshall & King Associates, Ltd., 96 Harlem Ave., White Plains, NY 10603, Noise Control Engr., 15 (2), pp 71-79 (Sept/Oct 1980) 8 figs, 15 refs

Key Words: Buildings, Noise reduction

Guidelines for achieving satisfactory noise control solutions in music education facilities are outlined. Sound isolation between critical spaces and airhandling system noise control are described.

81-246

A Versatile Panel Element for the Analysis of Shear Wall Structures

O.A. Pekau and H.P. Huttelmaier

Dept. of Civil Engrg., Concordia Univ., 1455 de Maisonneuve B./d., W., Montreal, P.Q., Canada H3G 1M8, Computers Struc., 42 (3), pp 349-359 (Sept 1980) 12 figs, 5 tables, 11 refs

Key Words: Buildings, Walls, Panels, Box type structures, Finite element technique

A panel element substructure is developed, defined in terms of boundary node arrangement and intended for use in efficient static and dynamic analysis of shear wall and box-type structures. The panel substructuring scheme is described as a multi-level super finite element technique based on a series of static condensations. Several numerical examples are presented to demonstrate the versatility and accuracy of the panel elements when used for either static or dynamic analysis.

81-247
Printing Press Automation and Noise Control
K. Lundin
IFM Akustikbyran AB, Warfvinges väg 26, S-11251 Stockholm, Sweden, Noise Control Engr., 15 (2), pp 65-69 (Sept/Oct 1980) 9 figs

Key Words: Industrial facilities, Presses, Printing, Noise reduction

A graphical calculation procedure for comparison of the two principal methods for reducing hearing damage risks in newspaper printing plants is outlined.

TOWERS
(Also see No. 251)

81-248
Aseismic Design of Towers, Tanks and Furnaces
X. Zhongquan
Ministry of Petroleum Industry, People's Republic of China, ASME Paper No. 80-C2/PVP-87

Key Words: Towers, Tanks (containers), Seismic design

The damage to towers, tanks, and industrial furnaces during earthquakes in China is described and cause of the damage is analyzed.

81-249
Effect of Dynamic Forces Upon the Carrying Metal Construction of Tower-Type Slewing Building Cranes (Účinok dynamických síl na nosnu ocel'ovú konštrukciu pri vežovýchotočných stavebných žeriavoch)
J. Košábek
Vysoká škola dopravná a spojov, 010 01 Žilina, Czechoslovakia, Strojnicky Časopis, 31 (3), pp 375-381 (1980) 4 figs, 6 refs
(In Slovak)

Key Words: Cranes (hoists), Construction equipment, Towers

Several methods for the calculation of the effect of the fluctuation of stress distribution on various tower crane structural elements are presented.

FOUNDATIONS
(Also see Nos. 220, 468)

81-250
Dynamic Axisymmetric Soil Model for a Flexible Ring Footing
O.M. El-Shafee and P.L. Gould
Dept. of Civil Engrg., Washington Univ., St. Louis, MO 63130, Intl. J. Earthquake Engr. Struc. Dynam., 8 (5), pp 479-498 (Sept/Oct 1980) 16 figs, 15 refs

Key Words: Footings, Finite element technique, Seismic excitation

A finite element model is developed to analyze flexible concentric ring footings under seismic loading. The model consists of isoparametric solid rotational elements with an energy transmitting boundary.

81-251
Influence of Geometry and of the Constitutive Law of the Supporting Columns on the Seismic Response of a Hyperbolic Cooling Tower
J.P. Wolf and P.E. Skrikerud
Electrowatt Engrg. Services, Ltd., Zurich, Switzerland, Intl. J. Earthquake Engr. Struc. Dynam., 8 (5), pp 415-437 (Sept/Oct 1980) 27 figs, 1 table, 13 refs

Key Words: Columns, Supports, Cooling towers, Seismic response, Geometric effects, Constitutive equations

Supporting columns and their foundation influence a cooling tower's seismic response decisively while representing the most vulnerable part of the structure. To determine the optimum seismic design, the influence of the geometry of the columns is investigated parametrically. The constitutive laws of the concrete and of the reinforcement steel in the columns as well as slipping and lift-off of the foundations are incorporated into a non-linear analysis.

81-252
Vibrations of the Elastic Half-Space Due to Vertical Surface Loads
U. Holzlöhner
Bundesanstalt fur Materialprüfung, Berlin, W. Germany, Intl. J. Earthquake Engr. Struc. Dynam., 8 (5), pp 405-414 (Sept/Oct 1980) 9 figs, 7 refs

Key Words: Interaction: soil-structure, Periodic response, Elastic half-space, Elastic properties

The displacements of the surface of the homogeneous elastic half-space subjected to a vertical concentrated load acting at the surface are calculated. The solution for the concentrated load can be used to calculate displacements due to distributed loads economically and with high accuracy.

81-253

Soil-Foundation Interaction and Differential Ground Motions

G.N. Bycroft

U.S. Geological Survey, Menlo Park, CA, Intl. J. Earthquake Engr. Struc. Dynam., 8 (5), pp 397-404 (Sept/Oct 1980) 7 figs, 8 refs

Key Words: Interaction: soil-structure, Foundations, Seismic design, Nuclear power plants, Dams, Bridges, Pipelines

A general method is developed for determining the motion of a large rigid mat foundation subjected to traveling surface waves and observations are made on the relative displacements of individual foundations and their importance in bridge failure.

UNDERGROUND STRUCTURES

81-254

Earthquake Damage to Underground Facilities

H.R. Pratt, D.E. Stephenson, G. Zandt, M. Bouchon, and W.A. Hustrulid

Terra Tek, Inc., Salt Lake City, UT, Rept. No. CONF-800603-1, 48 pp (1980)

DP-MS-78-92

Key Words: Underground structures, Earthquake damage, Damage prediction

In order to assess the seismic risk for an underground facility, a data base was established and analyzed to evaluate the potential for seismic disturbance. To evaluate potential displacements due to seismic effects of block motions along pre-existing or induced fractures, the displacement fields surrounding two types of faults were investigated.

81-255

Effects of Seismic Wave Propagation Upon Buried Pipelines

M.J. O'Rourke, G. Castro, and N. Centola

Dept. of Civil Engrg., Rensselaer Polytechnic Inst., Troy, NY, Intl. J. Earthquake Engr. Struc. Dynam., 8 (5), pp 455-467 (Sept/Oct 1980) 4 figs, 4 tables, 26 refs

Key Words: Underground structures, Pipelines, Seismic waves, Wave propagation

The behavior of long straight buried pipelines subjected to seismic wave propagation is investigated. Well-known relationships for determining upper bounds for the axial strain and curvature in the pipeline as well as relationships for relative displacement and rotation at the pipeline joints are discussed.

HARBORS AND DAMS

(See No. 479)

CONSTRUCTION EQUIPMENT

(Also see No. 249)

81-256

Dynamic Response of the Bridge Girders of E.O.T. Cranes Due to Dissimilar Rail Joints

V.V. Satyanarayana, D.P. Ghosh, and J.S. Rao

Mech. Engrg. M.I.T.S., Gwalior, India, Mech. Mach. Theory, 15 (5), pp 385-395 (1980) 8 figs, 6 refs

Key Words: Cranes (hoists), Bridges, Girders, Railroad tracks

Considering the bridge girder as a beam of constant flexural rigidity, the effects of dissimilar type of joints occurring simultaneously are studied by considering them as support excitation functions acting on either side of the bridge girder.

PRESSURE VESSELS

(Also see Nos. 265, 444, 447)

81-257

A Semi-Analytical Method for Aseismic Design of Cylindrical Vessels

L. Chaiyung

Design Inst., People's Rep. of China, ASME Paper No. 80-C2/PVP-86

Key Words: Pressure vessels, Seismic response

A semi-analytical method for stress analysis of cylindrical vessels subjected to lateral and vertical earthquake actions is presented. The basic step in the method is the choice of a trial solution which, because of the presence of undetermined parameters, actually represents a whole family of possible approximations.

81-258

Fatigue of Weldments in Nuclear Pressure Vessels and Piping

M.K. Booker, B.L.P. Booker, H.B. Meieran, and J. Heuschkel

Metals and Ceramics Div., Oak Ridge National Lab., TN, Rept. No. NUREG-CR-1351; NRNL/NUREG-64, 94 pp (Mar 1980)

N80-25706

Key Words: Piping systems, Pressure vessels, Welded joints, Nuclear reactor components, Fatigue life

Available information on fatigue of weldments relevant to nuclear pressure vessels and piping was reviewed and determined changes in the current design rules appear to be dictated by the available information. Information was obtained and summarized and stored in a computerized data management system to facilitate correlation of facts and development of conclusion.

81-259

Seismic Transient Analysis of a Containment Vessel with Penetrations

H.J. Dahlke and E.O. Weiner

Westinghouse Hanford Co., Richland, WA, ASME Paper No. 80-C2/PVP-81

Key Words: Containment structures, Shells, Seismic response

A linear transient analysis of a containment vessel was conducted to justify the load levels used for the seismic qualification testing of the heating and ventilation valve operators. Motions considered are horizontal, rocking and vertical input to the base, and the solution is carried out by direct integration.

POWER PLANTS

(Also see Nos. 239, 242, 258, 344, 345, 346, 347, 365, 369, 372, 394, 399, 400, 444, 468)

81-260

Probabilistic Seismic Safety Study of an Existing Nuclear Power Plant

R.P. Kennedy, C.A. Cornell, R.D. Campbell, S. Kaplan, and H.F. Perla

Structural Mechanics Associates, Inc., Newport Beach, CA 92660, Nucl. Engr. Des., 59 (2), pp 315-338 (Aug 1980) 7 figs, 7 tables, 21 refs

Key Words: Nuclear power plants, Earthquake response, Seismic response, Probability theory

This study was conducted as part of an overall safety study of the Oyster Creek nuclear power plant. The earthquake hazard was considered as an initiating event that could result in radioactive release from the site as a result of core melt. The probability of earthquake initiated releases were compared with the probability of releases due to other initiating events.

81-261

Seismic Analysis of the JT-60, (1). Analysis Method and Eigenvalue Analysis

H. Takatsu, M. Shimizu, M. Okumura, and M. Kawakami

Japan Atomic Energy Res. Inst., Tokyo, Japan, 159 pp (Mar 1979)

JAERI-M-8155

(In Japanese)

Key Words: Nuclear reactor components, Equipment response, Seismic analysis, Seismic design

Seismic analysis of a tokamak machine was carried out in order to confirm machine integrity in earthquakes in connection with any aseismic design changes. Described are an analysis method newly developed for seismic analysis of JT-60 and the results of eigenvalue analysis of the machine.

81-262

The Effect of Parameters of Construction and Flowing Medium on the Dynamics on the Fuel Rod (Vliv parametrů konstrukce a protékajícího média na dynamiku palivového prutu)

S. Konstantinidis and P. Rejf

SVÚSS, National Res. Inst. for Machine Design, 250 97 Praha 9-Bechovice, Czechoslovakia, Strojnicky Časopis, 31 (3), pp 331-341 (1980) 14 figs, 9 refs (In Czech)

Key Words: Nuclear fuel elements, Fluid-induced excitation

The effect of changing parameters of construction and medium flowing through a fuel element on the dynamics on the fuel rod is reported.

81-263

A Boundary Integral Method for Description of Fluid Interaction with Complex Three-Dimensional Structures

R. Krieg, B. Goller, and G. Hailfinger
Institut fur Reaktorentwicklung, Fed. Rep. of Germany, ASME Paper No. 80-C2/PVP-113

Key Words: Interaction: structure-fluid, Nuclear reactor components

A boundary integral method has been developed for highly transient potential flow problems with any three-dimensional geometry including walls wetted on both sides as well as free fluid surfaces. The applicability of the method is shown by three examples.

81-264

Comparison of Lagrangian, Eulerian and Arbitrary Lagrangian-Eulerian Methods for HCDA Analysis Involving Fluid-Structure Interaction

Y.W. Chang and J. Gvildys
Argonne National Lab., Argonne, IL, ASME Paper No. 80-C2/PVP-96

Key Words: Interaction: structure-fluid, Nuclear reactor components

An evaluation of Lagrangian, Eulerian and Lagrangian-Eulerian meshes is presented. The emphasis is on the applicability of the method in analyzing fluid-structure interaction problems in HCDA analysis.

81-265

Operation of a High Temperature Pressurized Water Fatigue Crack Growth System

W.H. Cullen, R.E. Taylor, and H.E. Watson
Naval Res. Lab., Washington, D.C., Closed Loop, 10 (2), pp 3-14 (Oct 1980) 17 figs, 4 refs

Key Words: Fatigue life, Crack propagation, Nuclear reactor components, Pressure vessels

In the normal course of operation of light water nuclear reactors, fluctuating water pressures, thermal stresses, mechanical vibrations and certain transients give rise to varying stress levels which could lead to measureable fatigue crack growth. As a result, determination of fatigue crack growth rates in pressure vessel and piping materials becomes an especially important component of reactor safety studies. Calculation of the in-service growth of some defect, and thus the total useful life of a PVP component, requires, as input, confident knowledge of the fatigue crack growth rates in an environment which simulates the water reactor coolant.

81-266

Modelling the WWER-Type Reactor Dynamics Using a Hybrid Computer. Part 2

J. Rubek
Vyzkumny Ustav Energeticky, Prague, Czechoslovakia, 161 pp
INIS-mf-5318
(In Czech)

Key Words: Mathematical models, Nuclear power plants, Nuclear reactor components

Results of modeling dynamic properties by a hybrid computer of the steam generator of a WWER type reactor power plant are given. A model was developed of the dynamics of a horizontal and a vertical steam generator. The dynamic properties were studied in a wide range of output changes; the effect was also studied of steam pressure in the generator evaporating zone.

81-267

Seismic Behavior of Reinforced Concrete Structures: Nonlinear Calculation and Experimental Verification

J. Gauvain, A. Hoffmann, C. Jeandidier, and M. Livolant
Dept. des Etudes Mecaniques et Thermiques, CEA Centre d'Etudes Nucleaires de Saclay, Gifsur-Yvette, France, Rept. No. CONF-7806167-2, 23 pp (1978)
CEA-CONF-4382

Key Words: Beams, Reinforced concrete, Buildings, Nuclear power plants, Seismic response

This study presents the tests of a reinforced concrete beam. Static and dynamic experimental tests on a shaking table have been carried out and a model reasonably accurate has been established and checked on the test results.

81-268
Hydroelastic Model of PWR Reactor Internals SAFRAN 1 - Validation of a Vibration Calculation Method
A. Epstein, R.J. Gibert, F. Jeanpierre, M. Livolant, and R. Assedo
Dept. des Etudes Mecaniques et Thermiques, CEA Centre d'Etudes Nucleaires de Saclay, Gifsur-Yvette, France, Rept. No. CONF-759589-4, 10 pp (1978)
CEA-CONF-4372

Key Words: Nuclear reactor components, Computer programs

The SAFRAN 1 test loop consists of a hydroelastic similitude of a 1/8 scale model of a 3-loop PWR. Vibrations of the main internals and pressure fluctuations in water thin sections between vessel and internals, and in inlet and outlet pipes, are measured.

81-269
Two-Dimensional Method of Characteristics for Fluid-Structure Interactions
K. Takeuchi and A.C. Spencer
Westinghouse Electric Corp., Pittsburgh, PA, ASME Paper No. 80-C2/PVP-114

Key Words: Computer programs, Interaction: structure-fluid, Nuclear reactor components

During a loss of coolant, the fluid-structure interactions in a PWR downcomer annulus due to the relative motion of the core barrel and the pressure vessel are important in calculation of the hydraulic force exerted on the reactor structure. In order to deal with this problem, the effect of structural motion is incorporated in CHARM, a two-dimensional method of characteristic code, modified with an additional corrector calculation. This corrector method is intended to improve the fluid flow distribution at every time step.

81-270
Dynamic Model Verification Studies for the Thermal Response of the Fort St. Vrain HTGR Core
S.J. Ball
Oak Ridge National Lab., TN, 16 pp (1980)
CONF-800332-3

Key Words: Mathematical models, Nuclear reactors

The safety research program for high-temperature gas-cooled reactors is directed primarily at addressing licensing questions on the Fort St. Vrain reactor near Denver, CO. An important part of the program is to make use of experimental data from the reactor to at least partially verify the dynamic simulations that are used to predict the effects of postulated accident sequences. Comparisons were made of predictions with data from four different reactor scram (trip) events from operating power levels between 30 and 50%. An optimization program was used to rationalize the differences between predictions and measurements.

OFF-SHORE STRUCTURES

81-271
Dynamic Response of a Double Articulated Offshore Loading Structure to Noncollinear Waves and Current
R.K. Jain and C.L. Kirk
Vickers Offshore Ltd., Barrow-in-Furness, UK, ASME Paper No. 80-Pet-56

Key Words: Offshore structures, Water waves

The dynamic response of a double articulated offshore loading structure to noncollinear waves and a steady current is studied for various waves and varying current directions. The governing equations of motion are derived by the Lagrange method where the wave and current forces are computed by a modified form of Morrison's equation which takes account of the relative motion of the water particles with respect to the oscillating structure.

VEHICLE SYSTEMS

GROUND VEHICLES

81-272
Techniques for Measurement of Wheel-Rail Forces
D.R. Ahlbeck and H.D. Harrison

Battelle, Columbus Labs., 505 King Ave., Columbus, OH 43201, Shock Vib. Dig., 12 (10), pp 31-41 (Oct 1980) 5 figs, 3 tables, 23 refs

Key Words: Interaction: rail-wheel, Measurement techniques

The basic phenomena of wheel/rail loads are examined briefly, the historical development of force measurement techniques is reviewed, and the current state-of-the-art in measurement techniques is summarized.

81-273

Impact of the Nonlinear Connection Torque Between Truck and Car-Body on the Transversal Stability of a Railway-Car

J. Richard and R. Joly

Institut Universitaire de Technologie, Cachar, France, J. Mech. Des., Trans. ASME, 102 (3), pp 603-610 (July 1980) 13 figs, 8 refs

Key Words: Railroad cars, Hunting motion

The dynamic behavior of a high speed free truck running on an aligned track under optimal geometric conditions is shown.

81-274

Measurements of Wheel/Rail Loads on Class 5 Track

D.R. Ahlbeck, M.R. Johnson, H.D. Harrison, and J.M. Tuten

Battelle Columbus Labs., Columbus, OH, Rept. No. FRA/ORD-80/19, DOT-TSC-FRA-80-6, 294 pp (Feb 1980)

PB80-196868

Key Words: Interaction: rail-wheel, Measurement techniques

Measurements are made on two tangent test sections and a curved test section to characterize the wheel/rail load environment on Class 5 track. Data obtained from these measurements is presented and a description of the wayside and vehicle-borne instrumentation, the experiment design and operation, and the data reduction and analysis approach employed is given. Statistical summaries of the load environments are presented.

81-275

Response of Vehicle Accelerating over Random Profile

D.B. Macvean

Dept. of Mech. Engrg., Univ. of Glasgow, Glasgow G12 8QQ, UK, Ing. Arch., 49 (5/6), pp 375-380 (1980) 3 figs, 8 refs

Key Words: Ground vehicles, Interaction: vehicle-terrain, Road roughness

Certain aspects of the complex dependence on parameters of the non-stationary random response of a simple model of a vehicle to road roughness are investigated numerically. Although the method is applicable to an arbitrarily varying traversal velocity, attention has been restricted to uniformly accelerated motion.

81-276

An Active and Passive Steering Controller Study of Rubber-Tired Automated Guideway Transit Vehicles

Y.K. Kwak and C.C. Smith

Dept. of Ordinance Engrg., Korea Military Academy, Seoul, Korea 713-55, J. Dyn. Syst., Meas. and Control, Trans. ASME, 102 (3), pp 168-173 (Sept 1980) 4 figs, 1 table, 11 refs

Key Words: Automated transportation systems, Steering gear, Surface roughness

A comparative study of an active and passive steering controller of a rubber-tired vehicle excited by random guideway irregularities is discussed. The thirteen-degree-of-freedom vehicle model, which was previously developed for passively steered rubber-tired AGT vehicles, is modified to facilitate the coupling of the vehicle to an active steering controller. Vehicle performance with the active steering controller, as well as the passive one, is evaluated in terms of root mean square values of the system outputs of interest.

81-277

Development and Performance of Passive Restraint Systems

W. Rosenau

Volkswagonwerk AG, Wolfsburg, W. Germany, Intl. J. Vehicle Des., 1 (4), pp 328-338 (Sept 1980) 15 figs, 3 refs

Key Words: Safety restraint systems, Automobile seat belts, Collision research (automotive)

The Volkswagen Automatic Restraint system is described. The system is composed of a torso belt with a dual sensitive automatic locking retractor, deformable kneebolster, seat and seat belt anchorage. The results of accident simulation tests carried out using a variety of fixed and angled collision barriers are presented.

SHIPS

(Also see No. 404)

81-278

Ship Vibrations in Random Seas

Y. Chen

Dept. of Naval Architecture, National Taiwan Univ., Taipei, Taiwan, ROC, J. Ship Res., 24 (3), pp 156-169 (Sept 1980) 14 figs, 2 tables, 44 refs

Key Words: Ships, Water waves

A general analysis of ship dynamics in random seas is presented. The analysis covers the steady-state wave-induced response and the transient-state slam-induced (whipping) response.

81-279

Surface Effect Ship Heave Control Using a Linear Regulator Design

D.H. Everett

Naval Postgraduate School, Monterey, CA, 107 pp (Mar 1980)

AD-A085 041/2

Key Words: Ships, Hydrofoil craft, Heaving

A control system was designed to attenuate vertical accelerations for the XR-3 captured air bubble type surface effect ship using linear regulator techniques applied to the simplified nonlinear equations of motion.

81-280

Vibrations of Marine Riser Systems

P.T.D. Spanos and T.W. Chen

The Univ. of Texas, Austin, TX, ASME Paper No. 80-Pet-69

Key Words: Marine risers, Water waves

A discrete multi-degree-of-freedom model is used to study the dynamic response of marine riser systems to loads generated by sea waves and currents. A linearization scheme is used to determine an approximate solution for the system response. A variety of studies regarding the effects of system and environmental parameters on the maximum bending stress and the maximum bottom angle are presented.

AIRCRAFT

(Also see No. 310)

81-281

Discrete Frequency Noise Reduction Modeling for Application to Fanjet Engines

S. Fleeter

School of Mech. Engrg., Purdue Univ., West Lafayette, IN 47907, J. Acoust. Soc. Amer., 68 (3), pp 957-965 (Sept 1980) 6 figs, 15 refs

Key Words: Engine noise, Jet engines, Noise reduction, Interaction: rotor-stator

A model for the generation of discrete frequency noise due to rotor-stator interactions in a fanjet engine is examined to ascertain its relevance to noise reduction studies. Predictions are obtained for the noise reduction between a base fan stage and one redesigned to achieve reduced discrete frequency noise utilizing response functions corresponding to incompressible flow isolated airfoil transverse and longitudinal gust analyses as well as incompressible and compressible flat plate airfoil cascade transverse gust analyses.

81-282

Research: Aircraft Noise Reduction in France

M. Pianko

NASA, Washington, D.C., Rept. No. NASA-TM-75832, 17 pp (June 1980), Engl. transl. from Voies-Aviation Civile (France), pp 31-34 (1979)

N80-29133

Key Words: Aircraft noise, Noise reduction

In 1967 the French aeronautics industry began extensive research in the field of noise abatement. Substantial progress is shown for both supersonic and subsonic transports as well as for helicopters.

81-283
Helicoidal Surface Theory for Harmonic Noise of Propellers in the Far Field
D.B. Hanson
Hamilton Standard Div., United Technologies Corp., Windsor Locks, CT, AIAA J., 18 (10), pp 1213-1220 (Oct 1980) 8 figs, 14 refs

Key Words: Aircraft noise, Propeller noise, Helicoidal membranes, Noise generation

The acoustic analogy is used to derive far-field radiation equations for high-speed propellers in flight via a helicoidal surface representation of the blades. The frequency domain results clarify the role of acoustic noncompactness; i.e., noise cancellation due to finite chord and span effects. The analysis extends, unifies, and refines the theories of several previous workers.

81-284
Analytical Design and Evaluation of an Active Control System for Helicopter Vibration Reduction and Gust Response Alleviation
R.B. Taylor, P.E. Zwicke, P. Gold, and W. Miao
United Technologies Res. Ctr., East Hartford, CT, Rept. No. NASA-CR-152377, 165 pp (July 1980)
N80-28369

Key Words: Helicopter vibration, Active control, Vibration control, Wind-induced excitation

An analytical study was conducted to define the basic configuration of an active control system for helicopter vibration and gust response alleviation. The study culminated in a control system design which has two separate systems: narrow band loop for vibration reduction and wider band loop for gust response alleviation.

81-285
Response of Nonlinear Structural Panels Subjected to High Intensity Noise
C. Mei
Dept. of Engrg. Mechanics, Missouri Univ., Rolla, MO, Rept. No. AFWAL-TR-80-3018, 56 pp (Mar 1980)
AD-A085 638/5

Key Words: Panels, Acoustic excitation, Fatigue life, Aircraft

Lightweight aircraft structures exposed to a high intensity noise environment can fatigue fail prematurely if adequate consideration is not given to the problem. Design methods and design criteria for sonic fatigue prevention have been developed based on analytical and experimental techniques. A large deflection geometrical nonlinearity was incorporated into the analysis methods for determining the structural response to high intensity noise.

81-286
Transonic Flutter Analysis of a Rectangular Wing with Conventional Airfoil Sections
F.E. Eastep and J.J. Olsen
Air Force Flight Dynamics Lab., Wright-Patterson AFB, OH, AIAA J., 18 (10), pp 1159-1164 (Oct 1980) 9 figs, 1 table, 14 refs

Key Words: Aircraft wings, Flutter

Flutter analysts have encountered considerable analytical difficulties in the prediction of the flutter stability of aircraft operating in the transonic Mach number regime. The finite-difference relaxation method is used to determine the oscillatory transonic aerodynamic forces on a uniformly stiff cantilever rectangular wing in a flowfield with mixed subsonic and supersonic regions together with shock waves. The flutter speed is determined at two transonic Mach numbers and is compared to the flutter speed obtained using a classical linear aerodynamic theory.

81-287
Summary of Aerodynamic Vibration Effects on All Turret
P. Merritt and L. Sher
Air Force Weapons Lab., Kirtland AFB, NM, In: NASA Ames Res. Ctr. Proc. of the Aero-Optics Symp. on Electromagnetic Wave Propagation from Aircraft, pp 515-535 (Apr 1980)
N80-25607

Key Words: Airborn equipment response, Aerodynamic excitation

The effects of airborne environment on a pointing and tracking system using a turret external to an aircraft are summarized. The data covers a series of flight tests and a span of seven years. The two major airborne effects are shown to be direct pressure loading of optical elements and vibrations of the entire turret.

81-288
UK Approach to Aircraft Dynamic Response on Damaged and Repaired Runways
B.W. Payne, A.E. Dudman, B.R. Morris, M. Ormerod, and C. Brain
British Aerospace Aircraft Group, Weybridge, UK, In: AGARD Aircraft Dyn. Response to Damaged Runways, pp 19-24 (Mar 1980)
N80-25327

Key Words: Interaction: wheel-pavement, Aircraft, Runway roughness

The operation of military aircraft from damaged and repaired runways was studied. Mathematical models and associated validation trails were successfully employed to predict the dynamic response of aircraft on damaged and repaired runways and together with engineering support trails allowed the operational capability of the aircraft to be defined, provided proper consideration be given to the variability of the environment and the aircraft.

81-289
Parameters Affecting Aircraft Performance on Runways in Bad Condition
A. Krauss, O. Bartsch, and G. Kempe
Messerschmitt-Boelkow-Blohm G.m.b.H., Munich, W. Germany, In: AGARD Aircraft Dyn. Response to Damaged Runways, pp 25-31 (Mar 1980)
N80-25328

Key Words: Interaction: wheel-pavement, Aircraft, Runway roughness

It is postulated that calculations of dynamic response to damaged runways must account for the nonlinearities of the undercarriage. Examples taken from simulations of the F-104G running across AM2 runway repair mats serve to identify the influence of some of these nonlinearities and to discuss possibilities to improve undercarriage performance. The subsequent considerations on structural response of the airframe deal with the validity of models and with cost effective ways of determining aircraft performance on runways in bad condition.

81-290
Aircraft Dynamic Response to Damaged Runways
AGARD, Neuilly-Sur-Seine, France, Rept. No. AGARD-R-685, Presented at the 49th Meeting of the Struct. and Mater. Panel, Porz-Wahn, West Germany, Oct 1979, 37 pp (Mar 1980)
N80-25325

Key Words: Interaction: wheel-pavement, Aircraft, Runway roughness

The potential problems of aircraft dynamic response to damaged and repaired runways were studied. Since landing gear equations are highly nonlinear, the prediction of aircraft dynamic response required time consuming numerical integrations.

81-291
A Comprehensive Analytical Model of Rotorcraft Aerodynamics and Dynamics. Part 1: Analysis Development
W. Johnson
NASA Ames Res. Ctr., Moffett Field, CA, Rept. No. NASA-TM-81182, 442 pp (June 1980)
N80-28296

Key Words: Computer programs, Helicopter vibrations, Wind-induced excitation

Structural, inertia, and aerodynamic models were combined to form a comprehensive model of rotor aerodynamics and dynamics that is applicable to a wide range of problems and a wide class of vehicles. A digital computer program is used to calculate rotor performance, loads, and noise: helicopter vibration and gust response; flight dynamics and handling qualities; and system aeroelastic stability.

81-292
A Comprehensive Analytical Model of Rotorcraft Aerodynamics and Dynamics. Part 2: User's Manual
W. Johnson
NASA Ames Res. Ctr., Moffett Field, CA, Rept. No. NASA-TM-81183, 97 pp (July 1980)
N80-28297

Key Words: Computer programs, Helicopter vibration, Wind-induced excitation

The use of a computer program for a comprehensive analytical model of rotorcraft aerodynamics and dynamics is described. The program calculates the loads and motion of helicopter rotors and airframe. First the trim solution is obtained, then the flutter, flight dynamics, and/or transient behavior can be calculated. Either a new job can be initiated or further calculations can be performed for an old job.

81-293
A Comprehensive Analytical Model of Rotorcraft Aerodynamics and Dynamics. Part 3: Program Manual
W. Johnson
NASA Ames Res. Ctr., Moffett Field, CA, Rept. No. NASA-TM-81184, 155 pp (June 1980)
N80-28298

Key Words: Computer programs, Helicopter vibration, Wind-induced excitation

The computer program for a comprehensive analytical model of rotorcraft aerodynamics and dynamics is described. This analysis is designed to calculate rotor performance, loads, and noise; the helicopter vibration and gust response; the flight dynamics and handling qualities; and the system aeroelastic stability. The analysis is a combination of structural, inertial, and aerodynamic models that is applicable to a wide range of problems and a wide class of vehicles. The analysis is intended for use in the design, testing, and evaluation of rotors and rotorcraft and to be a basis for further development of rotary wing theories.

MISSILES AND SPACECRAFT

(Also see Nos. 411, 421)

81-294
Symmetric Missile Dynamic Instabilities - A Review
C.H. Murphy
Ballistics Res. Lab., Army Armament Res. and Dev. Command, Aberdeen Proving Ground, MD, Rept. No. ARBRL-TR-02228, AD-E430 440, 42 pp (Mar 1980)
AD-A085 022/2

Key Words: Spacecraft, Missiles, Damping effects

Dynamic instabilities observed for symmetric missiles and projectiles arise from a large variety of causes. These include unstable linear damping moments, and different nonlinear in-plane and out-of-plane damping moments for nonspinning re-entry vehicles, nonlinear Magnus moments for spinning missiles, and internal resonance with moving payload components. If aerodynamic trim is present, linear spin-yaw resonance can occur as well as nonlinear subharmonic motions and a number of other limit motions. This report gives a complete survey of these possibilities with a number of actual case histories.

81-295
Optimal Large Angle Maneuvers with Simultaneous Shape Control/Vibration Arrest
J.D. Turner and J.L. Junkins
Virginia Polytechnic Inst. and State Univ., Blacksburg, VA, In: NASA Goddard Space Flight Ctr., Flight Mech./Estimation Theory Symp., pp 201-214 (1980)
N80-28398

Key Words: Spacecraft, Vibration control

A relaxation method is demonstrated which reliably solves the nonlinear two point boundary value problem which arises when optimal control theory is applied to determination of large angle maneuvers of flexible spacecraft. The basic ideas are summarized and several idealized maneuvers are determined. The emphasis is upon demonstrating the basic ideas and practical aspects of the methodology.

81-296
The Dynamics and Control of Large Flexible Space Structures, 3. Part A: Shape and Orientation Control of a Platform in Orbit Using Point Actuators
P.M. Bainum, A.S.S.R. Reddy, R. Krishna, and P.K. James
School of Engrg., Howard Univ., Washington, D.C., Rept. No. NASA-CR-163253, 179 pp (June 1980)
N80-27419

Key Words: Spacecraft, Control simulation

The dynamics, attitude, and shape control of a large thin flexible square platform in orbit are studied. Attitude and shape control are assumed to result from actuators placed perpendicular to the main surface and one edge and their effect on the rigid body and elastic modes is modeled to first order. The stability of the uncontrolled system is investigated analytically.

BIOLOGICAL SYSTEMS

HUMAN

81-297
A Mathematical Vibration Model of the Human Hand-Arm-System (Ein mathematisches Schwingungsmodell für das menschliche Hand-Arm-System)

G. Meltzer, R. Melzig-Thiel, and M. Schatte
ZIAS Dresden, East Germany, Maschinenbautechnik, 29 (2), pp 54-58 (1980) 4 figs, 15 refs

Key Words: Human hand, Mathematical models, Vibration response

Experimental results, based on mathematical description of vibration behavior of hand-arm system, are presented. The input admittance of the hand-arm system at different arm positions, pressure, and contact forces was measured in five people. After the significant test parameters were determined, seven vibration models were constructed for the hand-arm system with different parameter combinations.

MECHANICAL COMPONENTS

ABSORBERS AND ISOLATORS

81-298

Work of Magnetic Dynamic Absorber (Optimum Effect of Vibration Accompanied with Collision)

Y. Kurakake and Y. Hara
Sasebo Tech. College, Bull. JSME, 23 (181), pp 1206-1212 (July 1980) 6 figs, 2 refs

Key Words: Dynamic vibration absorption (equipment), Magnetic damping

As a vibrating system attached on a non-damped magnetic dynamic absorber, containing two fixed side magnets and an absorber magnet, is subjected to the action of an external periodic force, the absorber mass of the magnetic dynamic absorber collides with one or both side magnets when the system is excited. If the collision occurs periodically, the amplitude of the principal mass will be decreased. In this paper the steady-state vibration of the system accompanied with collision is analyzed.

81-299

Effective Weight: New Rating Tool

D.J. Gillies
Ace Controls, Inc., Farmington, MI, Mach. Des., 52 (20), pp 94-112 (Sept 11, 1980) 6 figs, 1 table

Key Words: Shock absorbers

A procedure for the selection of shock absorbers based on effective weight is described. It takes into consideration the effect of an inertial weight created by the propelling force on the shock absorber, requiring to absorb more work energy than calculated from work energy equation.

81-300

Tuned Dynamic Performance of Circular Step Bearings

F.A. Abdelhafez
Mech. Engrg. Dept., Al-Azhar Univ., Cairo, Egypt, Wear, 63 (1), pp 71-87 (Aug 15, 1980) 4 figs, 5 tables, 37 refs

Key Words: Bearings, Hydrostatic bearings, Vibration absorption (equipment), Tuned dampers, Viscous damping

In view of the increasing need for stable support the response of a dynamically loaded circular step bearing is investigated in which the resulting axial oscillations of the shaft runner can be damped out using a viscous damped vibration absorber. The stability analysis is intended to provide definite design parameters, to establish stability criteria and to indicate the influencing parameters. Conditions necessary for the design of the proposed supporting system are presented.

81-301

Magnetic Suspension for Rotating Equipment, Phase 1

K. Reistad, W. Ellison, and G. Yonkovich
Spin and Space Systems, Inc., Phoenix, AZ, Rept. No. NSF/RA-800046, 119 pp (Mar 1980)
PB80-196272

Key Words: Rotors (machine elements), Rotating structures, Magnetic suspension techniques

A study is presented which investigates the feasibility and design criteria for employing magnetic suspension in mechanisms intended for high rotational precision. The study includes a survey of magnetic suspension types and their basic characteristics. Attention is focused on control systems and magnetic circuit design and their interrelationships with the assembly structure and other components.

81-302
Vibration Absorbers for Damping of Solid State Noise
H. Albrecht
Messerschmitt-Boelkow-Blohm G.m.b.H., Munich, Germany, Rept. No. BMFT-FB-HA-79-03, 45 pp (May 1979)
N80-26677

Key Words: Vibration absorption (materials), Vibration damping, Machinery noise, Noise reduction

Methods were studied to damp mechanical vibrations of machines in industrial plants and thus achieve noise reductions. It is shown that metal bar absorbers of various shapes are more efficient than antidrumming compounds and sand of the same mass.

81-303
Preventing Ground Noise in Vibration Measurement Systems
J.E. Judd
Vibra-Metrics, Inc., Hamden, CT, Test, 42 (5), pp 12-15 (Oct/Nov 1980) 7 figs

Key Words: Measuring instruments, Isolation

Three methods are indicated for the isolation of unwanted signals in vibration measurement systems caused by ground currents flowing in the common and shield paths between the transducer and the signal-conditioner. The methods are the separate isolated mounting stud, internal isolation with external case ground, and external permanent isolation.

81-304
Development of an Exhaust Noise Suppressor with Negligible Back Pressure
P.J. VandenBrulle
Betriebsbereich Ottobrunn, Messerschmitt-Boelkow-Blohm G.m.b.H., Munich, West Germany, Rept. No. BMFT-FB-HA-79-02, 33 pp (May 1979)
N80-26676

Key Words: Noise reduction, Exhaust noise, Mufflers

Methods of exhaust noise reduction were studied using mufflers of small sizes and negligible back pressures. One muffler was designed to permit the adding in series of an ejector with ejector chamber; another muffler was developed using a combination of ejector effect, partitioning of the jet stream, and acoustic absorption.

81-305
Modelling the Hydraulic Coupling Systems of Automobile Suspension
E. Kaminski and J. Pokorski
Instytut Pojazdow, Politechnika Warszawska, Warsaw, Poland, Strojnicky Časopis, 31 (1), pp 107-115 (1980) 4 figs, 1 table, 4 refs
(In Russian)

Key Words: Suspension systems (vehicles), Hydraulic systems, Mathematical models

An algorithm to compute the dissipation matrix for linear hydraulic systems of automobile suspensions is formulated. Examples for application of the above algorithm are given.

81-306
Experimental Method of the Identification of Dynamic Properties of a Vibro-Isolative System with a Rubber Spring
P. Tirinda and R. Chmúrny
Inst. of Machine Mechanics of the Slovak Academy of Sciences, Dubravska cesta, 809 31 Bratislava, Czechoslovakia, Strojnicky Časopis, 31 (2), pp 157-164 (1980) 2 figs, 8 refs

Key Words: Vibration isolation, Springs (elastic), Parameter identification technique

Problems of the experimental methods of measurement and identification of vibroisolation effects of a mechanical system with a rubber spring are analyzed. New possibilities in the methodical and practical handling of some problems bearing upon the identification of dynamical properties of the vibroisolation system with real viscoelastic elements are presented.

SPRINGS

81-307
Compression Springs – Novel Components (Kompressibilitätsfedern – neuartige Bauelemente)
K. Schrader

Ingenieurhochschule Zwickau, Sektion Technologie, Germany, Maschinenbautechnik, 29 (7), pp 306-308 (1980) 6 figs, 5 refs
(In German)

Key Words: Springs (elastic), Vibration damping

A new type of compression spring is described in which the compressible element is an elastomer. The springs are characterized by a frequency-dependent damping, temperature dependent prestressing force and their functional dimensions. This new type of component may be used for small as well as for very large spring forces; e.g., for absorbing mass forces or high damping of vibrations.

TIRES AND WHEELS

81-308

Tire Stiffness and Damping Determined from Static and Free-Vibration Tests

R.K. Sleeper and R.C. Dreher
NASA Langley Res. Ctr., Langley Station, VA, Rept. No. NASA-TP-1671, 45 pp (July 1980)
N80-27302

Key Words: Tires, Stiffness coefficients, Damping coefficients, Vibration tests

Stiffness and damping of a nonrolling tire were determined experimentally from both static force-displacement relations and the free-vibration behavior of a cable-suspended platen pressed against the tire periphery. Lateral and force-and-aft spring constants and damping factors of an aircraft tire for different tire pressure and vertical loads were measured assuming a rate-independent damping form. A technique was applied for estimating the magnitude of the tire mass which participates in the vibratory motion of the dynamic tests.

81-309

A Model for the Radical Dynamic Behaviour of Pneumatic Tyres

R.J. Hooker
Dept. of Mech. Engrg., Univ. of Queensland, St. Lucia, Queensland, Australia, Intl. J. Vehicle Des., 1 (4), pp 361-372 (Sept 1980) 10 figs, 7 refs

Key Words: Tires, Pneumatic tires, Dynamic tests

A simple physical model is developed to represent the radial dynamic properties of a pneumatic tire, based on the determination of parameters using a drum-type testing machine. Results of tests over ranges of vibration amplitude and frequency, road speed and tire pressure are presented for a typical passenger car cross-ply tire and a radial-ply tire of the same size.

BLADES

(Also see Nos. 224, 226)

81-310

Flapping Response of Lifting Rotor Blades to Spanwise Nonuniform Random Excitation

F.Y.M. Wan
Dept. of Mathematics and Inst. of Applied Mathematics and Statistics, Univ. of British Columbia, Vancouver, B.C., V6T 1W5, Canada, J. Engr. Math., 14 (4), pp 241-261 (Oct 1980) 6 figs, 2 tables, 10 refs

Key Words: Blades, Rotary wings, Random excitation

Second-order rigid flapping response statistics of lifting rotor blades are obtained by a spatial correlation method for a general linear PDE with random forcing. These statistics enable us to analyze the effect of a finite correlation length of a spanwise nonuniform random excitation on the flapping blade response.

81-311

A Numerical Technique for Calculation of the Noise of High-Speed Propellers with Advanced Blade Geometry

P.A. Nystrom and F. Farassat
NASA Langley Res. Ctr., Langley Station, VA, Rept. No. NASA-TP-1662; L-13535, 33 pp (July 1980)
N80-27161

Key Words: Blades, Propeller blades, Noise generation, Numerical methods, Computer programs

A numerical technique and computer program were developed for the prediction of the noise of propellers with advanced geometry. The blade upper and lower surfaces are described by a curvilinear coordinate system, which was also used to divide the blade surfaces into panels. Two different acoustic formulations in the time domain were used to improve the speed and efficiency of the noise calculations. Algorithms used in some parts of the computer program are discussed. Comparisons with measured acoustic data for two model high speed propellers with advanced geometry are also presented.

81-312
Nonlinear Aeroelastic Equations of Motion of Twisted, Nonuniform, Flexible Horizontal-Axis Wind Turbine Blades
K.R.V. Kaza
Toledo Univ., OH, Rept. No. NASA-CR-159502, 70 pp (July 1980)
N80-26774

Key Words: Blades, Turbine blades, Wind turbines, Equations of motion

The second-degree nonlinear equations of motion for a flexible, twisted, nonuniform, horizontal axis wind turbine blade were developed. A mathematical ordering scheme which was consistent with the assumption of a slender beam was used to discard some higher-order elastic and inertial terms in the second-degree nonlinear equations.

81-313
Vibration Analysis of Turbomachinery Blades Using Dedicated Discretization and Twisted Beam Theory
B. Downs
Dept. of Mech. Engrg., Loughborough Univ. of Tech., Loughborough, Leicestershire, UK, J. Mech. Des., Trans. ASME, 102 (3), pp 574-578 (July 1980) 2 figs, 2 tables, 17 refs

Key Words: Beams, Blades, Turbomachinery blades, Stiffness coefficients, Mass coefficients

A method of discretizing the stiffness and mass properties of beam segments of turbine or compressor blades is presented. The theory encompasses both the modification of beam bending and torsional stiffnesses due to pretwist and the coupling of bending and torsional deformation with axial deformation occasioned by pretwist.

81-314
Acoustic Design of Machines - A Primary Noise Abatement Technique (Akustische Auslegung von Maschinen - ein Weg zur primären Lärmbekämpfung)
P. Költzsch
Bergakademie Freiberg, Zentralinstitut fur Arbeitsschutz, Dresden, E. Germany, Maschinenbautechnik, 29 (7), pp 292-294 (1980) 5 figs, 3 refs
(In German)

Key Words: Blades, Sound power levels, Noise reduction, Design techniques

A method for the calculation of sound power of an axial blade grating in flow machinery is presented. The results are used for the acoustical design of such machinery.

BEARINGS
(Also see No. 300)

81-315
Rotor-Bearing Dynamics Technology Design Guide. Part V. Dynamic Analysis of Incompressible Fluid Film Bearings
P.E. Allaire, J.C. Nicholas, E.J. Gunter, and C.H.T. Pan
Shaker Res. Corp., Ballston Lake, NY, Rept. No. SRC-78-TR-35, AFAPL-TR-78-6-PT-5, 95 pp (Mar 1980)
AD-A085 106/3

Key Words: Bearings, Rotor-bearing sytems, Design techniques, Fluid-film bearings, Tilting pad bearings

The equilibrium position, bearing coefficients, friction torque, and oil flow for plain journal, multilobe, and tilting pad journal bearings are presented. For multilobe bearings, various combinations of preload, number of pads, and load direction are evaluated. Tilting pad bearings are analyzed for various combinations of length to diameter ratio, preload, number of pads, and load direction.

81-316
The Determination of Spring and Damping Coefficients of Friction Bearings by Means of Parameter Identification (Ermittlung der Feder- und Dämpfungskonstanten von Gleitlagern durch parametrische Identifikation)
R. Nordmann and K. Schollhorn
VDI-Berichte, 381, pp 139-146 (1980) 11 figs, 6 refs
(In German)

Key Words: Parameter identification technique, Bearings, Friction bearings, Spring constants, Damping coefficients

A simple method for the determination of spring and damping coefficients of friction bearings is presented. The method consists of measuring the flexibility transfer function in the usual way, obtaining from it complex stiffnesses by inversion from which the desired coefficients can be easily calculated.

81-317

Test Stand Determination of Link Bearing Life (Ermittlung der Lebensdauer von Gelenklagern auf dem Prüfstand)

G. Bock, M. Kretschy, and H. Beckert

VEB Gelenkwellenwerk Stadfilm, East Germany, Maschinenbautechnik, 29 (2), pp 83-85 (1980) 6 figs, 3 refs

(In German)

Key Words: Bearings, Fatigue life

The failure of link bearings caused by wear is investigated statistically. An equation containing torque, velocity and deflection angle parameters is derived, which enables to calculate fatigue life with a 50% survival probability during a quasistationary operation. The effects of operating parameters on fatigue life are discussed.

81-318

Dynamic Characteristics of a Hydrostatic Journal Bearing

Y.S. Ho and N.N.S. Chen

Dept. of Mech. and Marine Engrg., Hong Kong Polytechnic, Hong Kong, Wear, 63 (1), pp 13-24 (Aug 15, 1980) 18 figs, 6 refs

Key Words: Bearings, Hydrostatic bearings, Journal bearings, Dynamic response

The results of experimental investigations into the performance of a six-pocket hydrostatic journal bearing subjected to a range of dynamic loads are presented. The bearing performance was studied in terms of the load-carrying capacity and oil-film stiffness.

81-319

Stiffness of Deep-Groove Ball Bearings

H.R. El-Sayed

Production Engrg. Dept., Faculty of Engrg., Alexandria Univ., Alexandria, Egypt, Wear, 63 (1), pp 89-94 (Aug 15, 1980) 6 figs, 9 refs

Key Words: Bearings, Ball bearings, Machine tools, Stiffness coefficients

Ball bearing stiffness is an important parameter in the design of machine tool spindles because of its effect on the performance of the spindle system. An equation for predicting the stiffness of deep-groove ball bearings is derived and expressed in terms of the available bearing dimensions.

81-320

Improving Wear Resistance of Spherical Bearings

P.T. Sampat

Heim, Div. of Incom International Inc., Fairfield, CT, Mach. Des., 52 (23), pp 162-167 (Oct 9, 1980) 4 figs, 2 tables

Key Words: Bearings, Spherical bearings, Wear

Some spherical bearings have exhibited only moderate service life when subjected to severe dynamic loads, high surface speeds, or extreme temperatures. It is shown that better combinations of lubricants and materials have recently provided improved operating characteristics.

BELTS

81-321

A Study on Strength of Toothed Belt (5th Report, Effect of Pitch Difference on Fatigue Strength of Toothed Belt)

T. Koyama, M. Kagotani, T. Shibata, S. Sato, and T. Hoshiro

Osaka Inst. of Tech., Osaka, Japan, Bull. JSME, 23 (181), pp 1240-1244 (July 1980) 11 figs, 4 refs

Key Words: Belts (moving), Fatigue life

The relationship between the pitch difference and fatigue strength for L-belt section of polychloroprene rubber and polyurethane toothed belts is researched.

GEARS

81-322

Modal Analysis on Standard Gear Units

J. Van Haren, L. De Wachter, and P. Vanhonacker

Katholieke Universiteit Leuven, Belgium, ASME Paper No. 80-C2/DET-79

Key Words: Modal analysis, Gears

Analysis techniques of mechanical structures, aimed at characterizing their dynamic behavior are presented. At present, modal analysis is commonly used to generate an animated representation of the different mode shapes. In this way, a number of vibration, as well as acoustic problems, can be solved.

81-323

The Analytical and Experimental Evaluation of Resonant Response in High-Speed, Lightweight, Highly Loaded Gearing

R.J. Drago and F.W. Brown

Boeing Vertol Co., Philadelphia, PA, ASME Paper No. 80-C2/DET-22

Key Words: Gears, Natural frequencies, Mode shapes

The causes and effects of gear resonance, experimental and analytical methods for identifying resonant frequencies and mode shapes, and methods for use in the design and hardware stages to avoid the coincidence of exciting and natural frequencies are described.

81-324

Vibration Problems with Large Reduction Gears in Marine Engines (Schwingungsprobleme bei Grossgetrieben in Schiffsmaschinen)

W. Pinnekamp

Zugspitzstrasse 2, D-8901, Kissing, Germany, MTZ Motortech. Z., 41 (9), pp 355-361 (Sept 1980) 7 figs (In German)

Key Words: Torsional vibration, Gear drives, Marine engines, Diesel engines

Torsional vibrations are known to create problems in drive units, particularly when equipped with reduction gears. It is true that these vibrations are not caused by the gear, but their reaction on the gear may result in trouble. From the point of view of a manufacturer of large reduction gears, some special problems are discussed in this paper which have occurred and frequently had to be solved in practice.

81-325

Bending Fatigue Tests of High Speed Spur Gears

I. Yuruzume and H. Mizutani

Mech. Engrg. Lab., Ibaraki, Japan, ASME Paper No. 80-C2/DET-87

Key Words: Gears, Spur gears, Fatigue tests, Flexural vibration

High speed bending fatigue tests of gears by shifting the tooth profile of gears by 0.35 and 0.8 respectively were carried out. At the same time to clarify the performance of gears during the operation of them under load, obtained results were compared with those obtained by using gears of the standard tooth profile.

81-326

Dimensional Stability and Fatigue Resistance of Acetal Homopolymer Gears Forced in the Solid State

M. Brezina, M. Bertrand, and P. Wieser

Univ. of Sherbrooke, Quebec, Canada, ASME Paper No. 80-C2/DET-106

Key Words: Gears, Fatigue life

The influence of process parameters on the geometry, on the dimensional stability and on the mechanical properties of acetal homopolymer power spur gears forged in the solid state from extruded preheated billets is discussed.

81-327

Bending Fatigue Strength of Spur Gears in Vacuum

S. Oda and K. Tsubokura

Faculty of Engrg., Tottori Univ., Tottori, Japan, Bull. JSME, 23 (181), pp 1228-1234 (July 1980) 12 figs, 3 tables, 8 refs

Key Words: Gears, Spur gears, Fatigue life, Fatigue tests

A study on the bending fatigue characteristics of normalized S45C spur gears in vacuum under two-step loading conditions as well as uniform cyclic loading is presented. For this experiment a gear bending fatigue testing machine of hydraulic type was used with a vacuum chamber of stainless steel.

81-328
Study on Pitch Circle Impulse Noise of Gear by Simulated Gear Tooth Contact
K. Ishida and T. Matsuda
Univ. of Shizuoka, Japan, ASME Paper No. 80-C2/DET-69

Key Words: Gears, Noise generation, Surface roughness

Pitch circle impulse noise which is representative of friction noise of the gear is simulated by the contact generated between two disks. The equivalent pitch circle impulse noise and vibration are analyzed by phase-plane analysis, and this analysis is confirmed by experiments on noise and vibration.

81-329
Effect of Tooth Surface Roughness on Gear Noise and Gear Noise Transmitting Path
K. Ishida and T. Matsuda
Fukui Inst. of Tech., Japan, ASME Paper No. 80-C2/DET-70

Key Words: Gears, Noise generation, Surface roughness

Gear noise due to tooth surface roughness is simulated by the disk machine in which rolling and sliding contact are generated between two disks. Surface roughness of the disk and experimental results of noise and vibration are expressed by frequency spectra. Noise transmitting path is deduced by the construction of the disk system, and frequency transfer function from surface roughness to noise is obtained on the basis of the above path and spectra.

81-330
On the Study of the Sound of Gear and Gear Box Using Acoustical Holography
K. Imezawa and H. Houjoh
Tokyo Inst. of Tech., Japan, ASME Paper No. 80-C2/DET-44

Key Words: Gears, Gear boxes, Gear noise, Noise source identification, Acoustic holography

A new system using acoustical holography that can show the location of the sound sources radiated by a machine is developed. The paper surveys the qualitative elucidation of the fundamental behavior of gear sound and then considers, for noise reduction, the mechanisms of propagation of the sound radiated from inside to outside of gear box.

81-331
Toothed Gear Drive Noise Reduction by Means of Elastically Supported Housings (Verringerung des Geräusches von Zahnradgetrieben durch Anwendung elastisch abgestützer Gehause)
M. Wiltzsch
Zentralinstitut fur Arbeitsschutz Dresden, Maschinenbautechnik, 29 (1), pp 17-22 (1980) 11 figs, 15 refs (In German)

Key Words: Gear drives, Noise reduction, Gear noise, Housings

The possibility of reducing the sound emission of toothed gear drives by interruption of the solid sound bow is presented. Tests have been made on four gears where the box was divided into a supporting and a very thin-walled housing.

COUPLINGS
(Also see No. 225)

81-332
Combatting Vibration with Mechanical Couplings
H. Schwerdlin and R. Eshleman
R & D Engr., Lovejoy, Inc., Downers Grove, IL, Mach. Des., 52 (20), pp 66-70 (Sept 25, 1980) 11 figs

Key Words: Couplings, Vibration control

A vibration orientated approach in the selection of mechanical drive couplings, which may govern natural frequencies of the entire system, is described. It includes one or more considerations involving industry standards, mathematical modeling, or experimentation.

81-333
The Radial Behavior of Gear Couplings
R. Fleiss
Development and Production-Organization, Neukirche, W. Germany, ASME Paper No. 80-C2/DET-64

Key Words: Gear couplings, Couplings, Flexible couplings, Torsional response, Flexural response

The mechanical behavior of a flexible gear coupling is analyzed. The kinematic and load distribution theory for a gear coupling, the effect of tooth pitch error on the couplings radial displacement, torsional displacement and bending moment reactions are discussed.

81-334
Easy Alignment Measurements for Gear-Type Couplings
M.G. Murray, Jr.
Exxon Chemical Co., U.S.A., Baytown, TX, Hydrocarbon Processing, 59 (9), pp 245-246 (Sept 1980) 1 fig

Key Words: Couplings, Gear couplings, Alignment, Measurement techniques

Traditional alignment measurement methods require coupling disassembly to expose the hubs, or attachment of a jig post to the shaft. Neither procedure is necessary. Guidelines are given for easy and accurate measurements.

LINKAGES

81-335
Survey: 2-Dimensional Motion and Impact at Revolute Joints
R.S. Haines
Dept. of Mech. Engrg., Univ. of Newcastle upon Tyne, NE1 7RU, UK, Mech. Mach. Theory, 15 (5), pp 361-370 (1980) 1 table, 62 refs

Key Words: Linkages, Joints (junctions)

The survey is confined to plain unlubricated revolute joints in which the relative motion is sensibly 2-dimensional, a topic shown to give rise to certain distinctive problems. Emphasis is placed on motion in continuous contact, but relative motion across the clearance, impact and rebound, and restoration of continuous contact are also covered.

VALVES
(See No. 369)

SEALS

81-336
Dynamic Analysis of Noncontacting Face Seals
I. Etsion
NASA Lewis Res. Ctr., Cleveland, OH, Rept. No. NASA-TM-79294; E-458, 40 pp (May 1980)
N80-27695

Key Words: Seals (stoppers), Dynamic structural analysis

The dynamic behavior of a noncontacting coned face seal is analyzed taking into account various design parameters and operating conditions. The primary seal ring motion is expressed by a set of nonlinear equations for three degrees of freedom. The effect of various parameters on seal stability is discussed and an empirical expression for critical stability is offered.

STRUCTURAL COMPONENTS

BARS AND RODS
(Also see No. 345)

81-337
Out-of-Plane Vibration of Arc Bar of Variable Cross-Section
T. Irie, G. Yamada, and I. Takahashi
Faculty of Engrg., Hokkaido Univ., Sapporo, Bull. JSME, 23 (181), pp 1200-1205 (July 1980) 8 figs, 8 refs

Key Words: Bars, Curved beams, Variable cross-section, Transfer matrix method, Natural frequencies, Mode shapes

The free out-of-plane vibration of an arc bar of variable cross-section is analyzed by use of the transfer matrix approach. This method is applied to bars of linearly, parabolically and exponentially varying rectangular cross-sections, and the effects of the varying cross-section and slenderness ratio are studied.

81-338
Identification of the Dynamic Visco-elastic Properties under Longitudinal Impact (3-Parameter Standard Solid Model)
H. Matsumoto, I. Nakahara, and H. Sekino

Tokyo Inst. of Tech., Tokyo, Japan, Bull. JSME, 23 (181), pp 1086-1091 (July 1980) 10 figs, 8 refs

Key Words: Bars, Viscoelastic properties, Axial excitation

The mechanical properties of PMMA were assumed to be reproduced from a three-parameter solid type of mathematical model consisting of a spring in parallel with a Maxwell element. The longitudinal strain variations were measured at two different locations in a bar of PMMA. The dynamical three parameters at different stages of iteration were given.

81-339

Coupled Free, Torsional and Axial Vibration of Pre-Twisted Bars

G. Curti and A. Risitano

Istituto di Costruzione di Macchine, Politecnico di Torino, Meccanica, 14 (3), pp 157-162 (Sept 1979) 7 figs, 1 table, 23 refs

Key Words: Bars, Initial deformation effects, Torsional vibration, Axial vibration

The calculation of natural frequencies in a pre-twisted solid with constant cross-section is presented. The axial and torsional displacements of cross-sections are taken into account, as well as the relative inertia forces and couples. The differential equations of the vibration are integrated and their general solution is given.

BEAMS

(Also see Nos. 267, 313, 373, 377, 378, 450)

81-340

Flexural Vibrations of Strongly Anisotropic Beams

M. Sayir

Institut fur Mechanik, ETH-Zentrum, CH-8092, Zurich, Switzerland, Ing. Arch., 49 (5/6), pp 309-323 (1980) 6 figs, 9 refs

Key Words: Beams, Flexural vibration, Fiber composites

If in a transversally vibrating beam of fiber-reinforced material the fibers are much stiffer than the matrix material, the influence of shear might be dominant even for wave lengths which are large as compared with the thickness of the beam. It is shown here by asymptotic solutions of the three-dimensional equations of linear elasticity for transversal isotropy that a dimensionless parameter characterizes the dynamic behavior.

81-341

The Deformation Energy Analysis of a Flexurally Vibrating Sandwich Beam (Rozbor deformacnej energie ohybovo kmitajuceho sendvicoveho nosnika)

O. Šimková and S. Markuš

Inst. of Machine Mechanics, Slovak Academy of Sciences, Bratislava, Czechoslovakia, Strojnicky Casopis, 31 (1), pp 65-74 (1980) 5 figs, 1 table, 2 refs (In Slovak)

Key Words: Beams, Sandwich structures, Flexural vibration

The share of separate components of the deformation energy of a three-layered sandwich beam under flexural vibrations is treated. The results for a layered and homogeneous beam are discussed.

81-342

Experiments on Chaotic Motions of a Forced Nonlinear Oscillator: Strange Attractors

F.C. Moon

Dept. of Theoretical and Appl. Mechanics, Cornell Univ., Ithaca, NY 14853, J. Appl. Mech., Trans. ASME, 47 (3), pp 638-644 (Sept 1980) 11 figs, 17 refs

Key Words: Beams, Forced vibration

The forced vibrations of a buckled beam show nonperiodic, chaotic behavior for forced deterministic excitations. Using magnetic forces to buckle the beam, two and three stable equilibrium positions for the postbuckling state of the beam are found. The deflection of the beam under nonlinear magnetic forces behaves statically as a butterfly catastrophe and dynamically as a strange attractor. The forced nonperiodic vibrations about these multiple equilibrium positions are studied experimentally using Poincare plots in the phase plane.

81-343

Dynamic Aspects of the Error in Eccentric Beam Modelling

R.E. Miller

Dept. of Theoretical and Appl. Mechanics, Univ. of Illinois at Urbana-Champaign, IL, Intl. J. Numer. Methods Engr., 15 (10), pp 1447-1455 (Oct 1980) 6 figs, 3 tables, 10 refs

Key Words: Error analysis, Finite element technique, Free vibration, Beams, Stiffened plates

The usual linear shape function for approximating axial displacements in beam finite elements used as eccentric stiffeners or as portions of composite cross-sections, leads to an error in the static deflection. A modified element reduces this error. The behavior of these two elements under free vibration is examined.

81-344

Vibrations of Square and Hexagonal Cylinders in a Liquid

T. Shimogo and Y. Shinohara

Keio Univ., Japan, ASME Paper No. 80-C2/PVP-97

Key Words: Multibeam systems, Nuclear reactor components, Submerged structures, Seismic response

A mathematical model is proposed to describe the dynamic behavior of square and hexagonal cylinder bundles immersed in a liquid. The hydrodynamic forces associated with cylinder motions are examined, and equations of motion of the spring-mounted cylinders including liquid coupling are derived. The results of this study have application in the modeling of vibration of a nuclear fuel assembly under the excitation of earthquakes.

81-345

Acoustic Loading Effects on Oscillating Rod Bundles

W.H. Lin

Argonne National Lab., Argonne, IL, ASME Paper No. 80-C2/PVP-124

Key Words: Rods, Multibeam systems, Acoustic excitation

An analytical study of the interaction between an infinite acoustic medium and a cluster of circular rods is made. The acoustic field due to oscillating rods and the acoustic loading on the rods are first solved in a closed form. The acoustic loading is then used as a forcing function for rod responses and the acousto-elastic couplings are solved simultaneously.

CYLINDERS

81-346

A Comparison of Experimental and Theoretical Vibration Results for Narrow Gap, Fluid-Coupled, Coaxial Flexible Cylinders

S.J. Brown, Jr. and B.W. Lieb

O'Donnell & Associates, Inc., Pittsburgh, PA, ASME Paper No. 80-C2/PVP-104

Key Words: Cylinders, Tubes, Fluid-induced excitation, Dynamic response, Finite element techniques, Nuclear reactor components

A comparison of theoretical and experimental results is presented for fluid-coupled coaxial cylinder dynamic response. The theoretical results involve 3-D linear finite element displacement methods employing plate structure and eight-node brick fluid elements. The objective is to demonstrate the range of fluid element applicability for typical PWR systems and, through comparison, quantify the relative significance of nonlinear effects.

COLUMNS

81-347

Dynamic, Inelastic Buckling Analysis of Mark I Torus Support Columns

B.J. Benda

Lawrence Livermore Lab., California Univ., Livermore, CA, Rept. No. NUREG-CR-1038; UCRL-52723, 62 pp (Sept 1979)

N80-25714

Key Words: Columns, Nuclear reactor components, Dynamic buckling

Columns that support the Mark I BWR containment tori are subjected to short-duration dynamic loads during some accident conditions. To accurately predict the actual response under these conditions, two different analysis methods were used. An effort to solve this dynamic, inelastic buckling problem was made; however, neither method adequately solved the problem. The results presented indicate that design modifications will be required either to reduce magnitude of the dynamic load or to increase the strength of the torus support columns.

FRAMES AND ARCHES

81-348
The Effect of Damping on Dynamic Snap-Through
E.R. Johnson
Dept. of Engrg. Science and Mechanics, Virginia Polytechnic Inst. and State Univ., Blacksburg, VA 24061, J. Appl. Mech., Trans. ASME, 47 (3), pp 601-606 (Sept 1980) 3 figs, 11 refs

Key Words: Arches, Snap-through problems, Damping effects

Dynamic snap-through criteria are compared for an impulsively loaded shallow circular arch modeled as a Kelvin-Voigt material. The Budinasky-Roth criterion is used in conjunction with direct numerical integration of an approximate set of motion equations to obtain critical magnitudes of the load as a function of small viscous damping and the spatial distribution of the load.

PLATES
(Also see Nos. 224, 237, 450)

81-349
Acoustic Scattering and Transmission of Wide-Band Plane Waves by Fluid Loaded Plates
P. Stepanishen and J. Guigli
Ocean Engrg. Dept., Univ. of Rhode Island, Kingston, RI 02881, J. Acoust. Soc. Amer., 68 (3), pp 980-988 (Sept 1980) 8 figs, 2 tables, 18 refs

Key Words: Plates, Acoustic scattering, Sound transmission, Fluid-induced excitation

Acoustic scattering and transmission of wide-band plane waves by fluid loaded plates is addressed using Timoshenko-Mindlin plate theory. The solution for the case of an impulsive excitation is first developed via the use of a double Fourier transform method. This solution is then used to develop the solutions for the scattered and transmitted fields corresponding to an arbitrary pulsed excitation via convolution integral relationships. The characteristics of the impulsive solutions are investigated as a function of incident angle.

81-350
Vibration of Beam Stiffened Skew Plates
N.C. Bhandari, K.K. Pujara, and B.L. Juneja
Mech. Engrg. Dept., Indian Inst. of Tech., Hauz Khas, New Delhi - 110 029, India, Strojnicky Časopis, 31 (1), pp 45-63 (1980) 14 figs, 4 tables, 36 refs

Key Words: Plates, Stiffened plates, Natural frequencies, Mode shapes

The method previously given by the authors for integral rib stiffened skew plate has been applied to a similar but fabricated construction in which ribs have been fixed to the plate by adhesive, for predicting their natural frequencies and mode shapes. Three different experimental models were tested.

81-351
Bending Vibration of Simply Supported Rectangular Plates with Internal Rigid Support
R. Solecki
The Univ. of Connecticut, Storres, CT 06268, Intl. J. Engr. Sci., 18 (11), pp 1309-1318 (1980) 2 figs, 3 tables, 14 refs

Key Words: Flexural vibration, Rdctangular plates, Plates

A previously derived invariant expression for the amplitude of the displacement of homogeneous, isotropic, harmonically vibrating plates with internal rigid supports or cracks is supplemented here by terms representing possible point discontinuities at the tips of the support or of the crack. This expression being given in tensor notation can be easily adapted to curvilinear plates with regular boundaries and arbitrary discontinuities and, in particular, to rectangular plates with curvilinear discontinuities. Vibration of a rectangular simply supported plate with arbitrarily located rectilinear rigid support is discussed as an example.

81-352
Dynamic Stability of Annular Plates under Pulsating Torsion
J. Tani and T. Nakamura
Inst. of High Speed Mechanics, Tohoku Univ., Sendai, Japan, J. Appl. Mech., Trans. ASME, 47 (3), pp 595-600 (Sept 1980) 7 figs, 1 table, 13 refs

Key Words: Annular plates, Plates, Galerkin method, Periodic excitation, Torsional excitation

The dynamic stability of annular plates under periodic torsion is analyzed by means of the Galerkin method in

conjunction with Hsu's procedure. The instability regions associated with both principal and combination parametric resonances are clarified for relatively low frequency ranges.

81-353

In-Plane Vibration of Annular Disks Using Finite Elements

V. Srinivasan and V. Ramamurti

Indian Inst. of Tech., Madras, India, J. Mech. Des., Trans. ASME, 102 (3), pp 585-588 (July 1980) 1 fig, 2 tables, 8 refs

Key Words: Plates, Annular plates, Finite element technique, Free vibration

The axisymmetric and asymmetric in-plane, free vibration of annular disks using the finite element method is discussed. The in-plane behavior is analyzed by annular ring segments using a Fourier series approach to model the problem asymmetries.

81-354

Dynamic Response of a Plate with Arbitrary Shape

K. Nagaya

Dept. of Mech. Engrg., Faculty of Engrg., Yamagata Univ., Yonezawa, Japan, J. Appl. Mech., Trans. ASME, 47 (3), pp 620-626 (Sept 1980) 6 figs, 11 refs

Key Words: Plates, Transient response, Fourier analysis

A method for solving dynamic response problems of a thin plate with arbitrary shape based on the classical plate theory is discussed. The result for an arbitrarily shaped plate subjected to general transient loads is obtained by utilizing the Fourier expansion collocation method. To verify the present method, numerical calculations are also carried out for a circular plate, and the results obtained are compared with the exact ones.

81-355

Thick Plate Subjected to Torsional Impact by a Rigid Circular Cylinder

H. Matsumoto, I. Nakahara, and Y. Okamoto

Tokyo Inst. of Tech., Tokyo, Japan, Bull. JSME, 23 (181), pp 1081-1085 (July 1980) 8 figs, 2 refs

Key Words: Plates, Impact response (mechanical)

The problem of a thick plate subjected to impact torsion by a rigid circular cylinder is analyzed based on the dynamic theory of elasticity. The dynamic stress intensity factor at the periphery of the contact region of the plate and the cylinder is investigated for the cases of a given rotational angle and torque.

81-356

Added Mass and Hydrodynamic Damping of Perforated Plates Vibrating in Water

D.F. DeSanto

Westinghouse Res. and Dev. Ctr., Pittsburgh, PA, ASME Paper No. 80-C2/PVP-121

Key Words: Plates, Hole-containing media, Hydrodynamic damping

Experiments are described in which the fluid dynamic forces acting on perforated plates vibrating in water were measured. The test results are expressed in terms of added mass and hydrodynamic damping. Dimensionless formulas are presented which give accurate values for the added mass of the plates tested and which yield satisfactorily conservative lower bounds for the hydrodynamic damping force in both the linear and nonlinear damping range.

81-357

Perturbation Solution for Impulsively Loaded Viscoplastic Plates

W. Wojno and T. Wierzbicki

Inst. of Fundamental Technological Res., Swietokrzyska 21, 00-49, Warsaw, Poland, Intl. J. Nonlin. Mech., 15 (3), pp 211-223 (1980) 9 figs, 2 tables, 18 refs

Key Words: Plates, Viscoelastic properties, Impact response (mechanical), Perturbation theory

A perturbation technique was used to determine large deflection response of viscoplastic clamped circular plates to uniform impulsive loading. Using a simple membrane model of the plate and assuming a strain rate dependence of the matched viscous type a non-linear eigenvalue problem for the determination of mode shape was formulated and solved.

81-358

Steady-State Response of Internally Damped Circular Plates

T. Irie, G. Yamada, and Y. Takeda
Dept. of Mech. Engrg., Faculty of Engrg., Hokkaido Univ., Sapporo, 060 Japan, J. Acoust. Soc. Amer., 68 (3), pp 922-928 (Sept 1980) 7 figs, 2 tables, 10 refs

Key Words: Plates, Annular plates, Circular plates, Internal damping, Periodic response

The steady-state nonaxisymmetrical response of a circular plate and an annular plate with internal damping to a sinusoidally varying force is determined by modal analysis. The transverse deflection of the plates is expressed by use of the Green function of the plates, and the driving-point impedance and transfer impedance are obtained analytically. The method is applied to a simply supported circular plate and a free-clamped annular plate driven at an arbitrary point; these responses of the plates are calculated numerically, and the effects of the internal damping and the location of the driving point on them are discussed.

SHELLS

(Also see Nos. 259, 368)

81-359

Dynamic Deformations and Stresses in a Circular Cylindrical Shell with Both Ends Clamped Subjected to Translational Excitations at the Base

S. Ujihashi, A. Itoh, H. Matsumoto, and I. Nakahara
Faculty of Engrg., Tokyo Inst. of Tech., 2-12-1, Ookayama, Meguro-ku, Tokyo, Japan, Bull. JSME, 23 (181), pp 1055-1063 (July 1980) 15 figs, 1 table, 10 refs

Key Words: Shells, Cylindrical shells, Impact response (mechanical)

An exact analysis for the dynamic stresses and deformations in a circular cylindrical shell with both ends clamped, subjected to impulsive motions at the clamped end, is presented on the basis of Flugge's dynamic shell theory and with use of Laplace transformation. The end motions are prescribed by three kinds of loading functions whose velocity histories in time are half sine, rectangular and exponentially decaying pulses, respectively.

81-360

Response of a Circular Cylindrical Shell to Disturbances in a Half-Space

N. El-Akily and S.K. Datta
Dept. of Mech. Engrg., Univ. of Colorado, Boulder, CO, Intl. J. Earthquake Engr. Struc. Dynam., 8 (5), pp 469-477 (Sept/Oct 1980) 3 figs, 15 refs

Key Words: Shells, Cylindrical shells, Circular shells, Asymptotic series, Successive approximation method

The response of a circular cylindrical shell to disturbances in an elastic half-space is studied. Two methods of solution are presented. The first is a method of matched asymptotic expansions, and the second is a method of successive reflections.

81-361

On Finite Element Large Displacement and Elastic-Plastic Dynamic Analysis of Shell Structures

T. Ishizaki and K. Bathe
Kure Res. Lab., Babcock Hitachi K.K. Takara-machi, Kure, Hiroshima 737, Japan, Computers Struc., 42 (3), pp 309-318 (Sept 1980) 21 figs, 35 refs

Key Words: Shells, Finite element technique, Elastic-plastic properties, Nonlinear response, Dynamic buckling, Initial deformation effects

Finite element procedures for nonlinear dynamic analysis of shell structures are presented and assessed. Geometric and material nonlinear conditions are considered. Some results are presented that demonstrate current applicabilities of finite element procedures to the nonlinear dynamic analysis of two-dimensional shell problems. The nonlinear response of a shallow cap, an impulsively loaded cylindrical shell and a complete spherical shell is predicted.

81-362

Effectiveness of Fluid Finite Elements in Transient Analyses of Fluid-Coupled Elastic Shell Systems

H. Huang, S. Halperson, and D. Curtis
Naval Res. Lab., Washington, D.C., ASME Paper No. 80-C2/PVP-135

Key Words: Shells, Interaction: structure-fluid, Transient response, Finite element technique

The effectiveness of the first order hexahedron ideal compressible fluid finite element based on displacement formulation is demonstrated by computing the transient response of two fluid-coupled cylindrical elastic shells impinged upon by a transversely incident pressure pulse and comparing results to an analytical solution.

81-363

Coupled Fluid Structure Analyses of a Thin Cantilevered Shell

R.E. Schneider and J.A. Stevens

Combustion Engrg., Inc., Windsor, CT, ASME Paper No. 80-C2/PVP-111

Key Words: Shells, Cantilever beams, Interacton: structure-fluid

The coupled fluid-structure dynamics of a short thin cantilevered cylindrical shell immersed within a fluid annulus has been investigated for two highly practical sample problems: the free vibration of an initially displaced shell and the response of a shell to blowdown induced excitation forces.

81-364

Transient Response of a Submerged Fluid-Coupled Double-Walled Shell Structure to a Pressure Pulse

H.C. Neilson, G.C. Everstine, and Y.F. Wang

D.W. Taylor Naval Ship R & D Ctr., Bethesda, MD, ASME Paper No. 80-C2/PVP-136

Key Words: Shells, Submerged structures, Interaction: structure fluid, NASTRAN (computer program), Computer programs, Finite element technique

A double-walled steel shell structure, submerged in water and flooded between the walls, was analyzed using the general-purpose finite element computer program NASTRAN, with explicit finite element modeling of the contained fluid and approximation of the external fluid-structure interaction effects by the DAA.

81-365

Three-Dimensional Linear Analysis of Fluid-Structure Interaction Effects in the Mark 1 BWR Pressure Suppression Torus

G.S. Holman, E.W. McCauley, and S.C. Lu

Lawrence Livermore Lab., Livermore, CA, ASME Paper No. 80-C2/PVP-146

Key Words: Interaction: structure-fluid, Shells, Nuclear reactor components, Finite element technique

Linear three-dimensional finite-element analyses that investigated the qualitative effect of torus wall flexibility on hydrodynamic loads induced by a nominal safety relief valve discharge are described.

81-366

Dynamic Buckling of Inelastic Spherical Shells

G.E. Funk and L.H.N. Lee

Rockwell International, Los Angeles, CA, ASME Paper No. 80-C2/PVP-88

Key Words: Shells, Spherical shells, Dynamic buckling

The dynamic buckling behavior of a complete spherical shell made of a bilinear or work hardening material and under a uniform external impulsive loading is investigated. A quasi-bifurcation theory and a minimum principle are employed to determine respectively the onset of the dynamic buckling process and the post-bifurcation nonlinear behavior.

PIPES AND TUBES

(Also see Nos. 255, 258, 391, 393, 403)

81-367

Pipe Whip Analysis of Unrestrained Piping Systems

D.K. Vijay and M.J. Kozluk

Ontario Hydro, Canada, ASME Paper No. 80-C2/PVP-149

Key Words: Piping sytems, Computer programs, Dynamic response

A high energy piping system is analyzed for a postulated break location which permits the piping to move a distance of over five pipe diameters before impacting a concrete wall. The ABAQUS computer code is used to perform a large-deflection, nonlinear dynamic analysis to predict the dynamic response of the piping and impacted structure.

81-368

Elastic Buckling Analysis of Buried Pipelines under Seismic Loads

C.C. Chen, L.H.N. Lee, and T. Ariman

Univ. of Notre Dame, Notre Dame, IN, ASME Paper No. 80-C2/PVP-76

Key Words: Pipelines, Underground structures, Seismic response, Shells, Cylindrical shells

The purpose of this work is to investigate the buckling failure mode of buried pipelines under seismic excitations, using a model of a cylindrical shell surrounded by uniform springs. Attention is focused on the parametric studies that concern the effects on dimensions of the pipe itself as well as the stiffness of the soil medium surrounding the pipe.

81-369

Fluid and Structure Dynamic Investigations of Check Valves Performed within the HDR Safety Program (Experimental and Analytical Results)

T. Grillenberger, L. Issler, G. Katzenmeier, and D.H. Scholl

Gesellschaft fur Reaktorsicherheit, Fed. Rep. of Germany, ASME Paper No. 80-C2/PVP-141

Key Words: Interaction: structure-fluid, Piping systems, Valves

At the HDR facility, several blowdown tests with quick-closing check valves were conducted. The valves under investigation were original check valves and the test pipe line similar to a feed water line in BWR's. The dynamic characteristics of valve, fluid and the piping system were measured.

81-370

Seismic Behavior of the Qinhuangdao/Beijing Oil Pipeline in the Tangshan Earthquake

C. Guan-Qing

Petroleum Industry Ministry, Beijing, People's Rep. of China, ASME Paper No. 80-C2/PVP-84

Key Words: Pipelines, Seismic response

Earthquake damage at four locations on an underground crude line passing through the seismic area is described. Taking into account the pipeline rigidity effect on the soil free deformation and various circumstances of different kinds of soils, a formula for aseismic calculation is suggested and a calculation method which closely conforms to the actual damage as well as the experimental results is recommended.

81-371

Earthquake Damage to Pipelines

S. Sholping

Municipal Engrg. Inst. of Beijing, Peoples Rep. of China, ASME Paper No. 80-C2/PVP-156

Key Words: Pipelines, Earthquake damage

A brief description and comparison of the damage caused by the earthquakes in China is given. The tests of pipeline joints in the laboratory are also presented and some suggestions on measures against earthquakes are made.

81-372

Dynamic Elastic-Plastic Behavior of Circumferential Cracks in a Pipe Subject to Seismic Loading Conditions

T.J. Griesbach

Combustion Engrg. Inc., Windsor, CT, ASME Paper No. 80-C2/PVP-151

Key Words: Piping systems, Pipes (tubes), Nuclear reactor components, Cracked media, Seismic response

An extensive analytical study is performed to investigate the structural stability and inherent integrity of the reactor coolant loop cold leg pipe containing hypothetical circumferential cracks. The purpose of this study is to gain a better understanding of the mechanisms and extent of crack opening behavior in a real piping system, and thus establish the basis for improved pipe break criteria.

81-373

Tube Bundle Vibrations in Transversal Flow

R.J. Gibert, J. Chabrerie, and M. Sagner

Dept. des Etudes Mecaniques et Thermiques, CEA Centre d'Etudes Nucleaires de Saclay, Gifsur-Yvette, France, Rept. No. CONF-780589-3, 9 pp (1978), Pres. at the Conf. on Vibration in Nuclear Plant, Keswick, UK, May 9, 1978

CEA-CONF-4373

Key Words: Tubes, Multibeam systems, Fluid-induced excitation

This study gives important information concerning characteristic parameters about lock-in and whirling instability phenomena, in the case of tube arrays. Several bundles with various usual pitches and arrangements are tested. Critical velocities are measured and the whirling instability characteristic coefficient is tabulated. A complementary experiment is made on tube rows with various pitches.

81-374

Pulse Propagation in Fluid-Filled Elastic Curved Tubes

C.K. Hu and J.W. Phillips

Univ. of Illinois, Urbana-Champaign, IL, ASME Paper No. 80-C2/PVP-126

Key Words: Tubes, Fluid-filled containers, Fluid-induced excitation, Pulse excitation

The propagation of fluid transients through elbows is studied. A set of one-dimensional governing equations for the propagation of pressure pulses in an inviscid compressible fluid contained in a thin-walled naturally curved elastic tube is formulated and solved by two different techniques.

81-375
Fluid-Structure Interactions in One-Dimensional Linear Cases
U. Schumann
Inst. fuer Reaktorentwicklung, Kernforschungszentrum Karlsruhe G.m.b.H., F.R. Germany, 70 pp (Jan 1979)
KFK-2723B

Key Words: Interaction: structure-fluid, Pipes (tubes), Linear theories

The interaction of pressure waves in a pipe with an elastic endwall is analyzed using a linear model. Two transient and two periodic cases are investigated.

81-376
A Simplified Seismic Design Procedure for Piping Systems
N. Pal
General Electric Co., Sunnyvale, CA, ASME Paper No. 80-C2/PVP-34

Key Words: Piping systems, Seismic design, Standards and codes

A general procedure is presented for simplified earthquake resistant design for piping systems including cable trays, electrical conduits and raceways, instrument and control lines used in power plants – nuclear, fossil, hydroelectric, solar, and chemical refineries and so-called life line (above ground) pipelines wherein resistance to seismic loads is an important design requirement.

81-377
Flow-Velocity-Dependence of Damping in Tube Arrays Subjected to Liquid Cross Flow
S.S. Chen and J.A. Jendrzejczyk
Argonne National Lab., Argonne, IL, ASME Paper No. 80-C2/PVP-129

Key Words: Multibeam systems, Tubes, Fluid-induced excitation, Damping effects

Experiments are conducted to determine the damping for a tube in tube arrays subjected to liquid crossflow; damping factors in the lift and drag directions are measured for in-line and staggered arrays. This study demonstrates that flow velocity-dependent damping is important.

81-378
Jet Swing as Governing Factor for Fluid-Elastic Instability of Tube Bundles
Y.N. Chen
Sulzer Bros., Ltd., Winterthur, Switzerland, ASME Paper No. 80-C2/PVP-103

Key Words: Tubes, Multibeam systems, Fluid-induced excitation

Fluid-elastic instability of a tube bundle is caused by feedback between tube vibration at its fundamental mode and flow path variation as a result of tube vibration. This flow path variation appears to originate from the capability of the jet to perform deflection or swing movement. The experimental results on the behavior of flow in two-tube-row banks and for in-line and staggered tube bundles reveal that jet deflection arises in the region of small lateral tube spacings.

81-379
Seismic Qualification of Pipe Span Carrying a Valve
M.Z. Lee
Gilbert Commonwealth Co., Reading, PA, ASME Paper No. 80-C2/PVP-82

Key Words: Piping systems, Seismic design, Supports

A problem frequently encountered in a simplified method of seismic support design for piping is to determine a span reduction factor and load multiplication factors for a span carrying a concentrated weight, such as a valve. An analytical method of computing these factors in a logical and fundamental manner is presented. The method is based on maximum stress considering the effect of the concentrated mass on the natural frequencies and the response acceleration.

DUCTS

81-380

Harmonic Linearization Method for High-Intensity Sound in Two-Dimensional Lined Ducts

M.S. Tsai
Boeing Commercial Airplane Co., Seattle, WA, AIAA J., 18 (10), pp 1180-1185 (Oct 1980) 3 figs, 2 tables, 17 refs

Key Words: Ducts, Acoustic absorption, Acoustic linings, Method of harmonic linearization

The harmonic linearization method is used to calculate the attenuation of the high-intensity sound in two-dimensional ducts of uniform cross section. The complex wave number in the transcendental equation is analytically expressed in terms of lining properties and sound pressure. Very good agreement between the calculated results and experimental data are obtained.

81-381

Sound Radiation from a Finite Length Unflanged Circular Duct with Uniform Axial Flow

K. Ogimoto
Inst. for Aerospace Studies, Toronto Univ., Downsview, Ontario, Canada, Rept. No. UTIAS-231; CN-ISSN-0082-5255, 172 pp (May 1980)
N80-27160

Key Words: Ducts, Sound waves, Aircraft noise, Engine noise

In addition to the noise caused by the turbulent jet exhaust flow, the noise generated by the fans and compressors operating in the inlet duct is a dominant contributor to the overall jet aircraft engine noise. To assist in improving the understanding of the basic characteristics of this type of noise source, a general theory is developed using a simplified model. This model consists of a finite length hard wall unflanged circular duct, an arbitrary general planar source distribution in the duct and a uniform axial flow inside and outside the duct radius.

81-382

Transfer Function Method of Measuring In-Duct Acoustic Properties. I. Theory

J.Y. Chung and D.A. Blaser
Engrg. Mechanics Dept., General Motors Res. Labs., Warren, MI 48090, J. Acoust. Soc. Amer., 68 (3), pp 907-913 (Sept 1980) 1 fig, 11 refs

Key Words: Ducts, Acoustic properties, Transfer functions

The theory of a transfer function method of measuring normal incident in-duct acoustic properties is presented. A broadband stationary random acoustic wave in a tube is mathematically decomposed into its incident and reflected components using a simple transfer-function relation between the acoustic pressure at two locations on the tube wall.

81-383

Transfer Function Method of Measuring In-Duct Acoustic Properties. II. Experiment

J.Y. Chung and D.A. Blaser
Engrg. Mechanics Dept., General Motors Res. Labs., Warren, MI 48090, J. Acoust. Soc. Amer., 68 (3), pp 914-921 (Sept 1980) 17 figs, 6 refs

Key Words: Ducts, Acoustic properties, Transfer functions

The transfer function method of measuring in-duct acoustic properties is described. Experimental results are presented to demonstrate the accuracy and the general utility of the method. Test results of the complex reflection coefficient, the complex acoustic impedance, and the transmission loss are found to agree well with theoretical predictions.

BUILDING COMPONENTS

(Also see No. 246)

81-384

Free Vibration Tests of Structural Concrete Walls and Analysis of Free Vibration Tests of Structural Walls

R.G. Oesterle, A.E. Fiorato, and J.D. Aristizabal-Ochoa
Construction Technology Labs., Portland Cement Assn., Skokie, IL, Rept. No. NSF/RA-800043, 43 pp (Feb 1980)
PB80-191232

Key Words: Vibration tests, Walls, Seismic design, Reinforced concrete, Natural frequencies, Damping characteristics

Experimental free vibration tests and results conducted during lateral load tests to determine frequency and damping characteristics of isolated wall specimens are described. This study is part of an experimental and analytical investigation of structural walls for earthquake-resistant buildings in which large isolated reinforced concrete wall specimens are tested under reversing in-plane lateral loads.

81-385

Simplified Investigation of Floors under Foot Traffic

R. Becker

Faculty of Civ. Engrg., Bldg. Res. Station, Technion - Israel Inst. of Tech., Technion, Haifa, Israel, ASCE J. Struc. Div., ST11 (106), pp 2221-2234 (Nov 1980) 7 figs, 12 refs

Key Words: Floors, Traffic-induced vibrations

A simplified procedure for computation of the maximum amplitude of vibration of floors under foot traffic is introduced. Two types of dynamic loads are considered: the heel drop load and a modified treading in place load. Dynamic response analysis of a simplified one degree of freedom damped system is used to relate maximum amplitudes of vibration to the static response under peak loads by means of dynamic magnification factors.

ELECTRIC COMPONENTS

CONTROLS (SWITCHES, CIRCUIT BREAKERS)

81-386

An Investigation of Earthquake Damage to Electrical Equipment

T. Weiming and Z. Shurui

General Inst. of Plant Design, Peoples Republic of China, ASME Paper No. 80-C2/PVP-85

Key Words: Electric power plants, Equipment response, Seismic response

Typical earthquake damage to electrical equipment including transformers, circuit breakers, arresters and accumulators is discussed and the cause of destruction to equipment with parts made of porcelain material is analyzed. A procedure to evaluate the dynamic reliability of such equipment under seismic circumstances is suggested.

DYNAMIC ENVIRONMENT

ACOUSTIC EXCITATION

(Also see Nos. 245, 247, 281, 283, 304, 311, 349, 482, 483)

81-387

Nonlinear Acoustic Wave Interactions in Layered Media

D.M. Yeager

Applied Res. Lab., Pennsylvania State Univ., University Park, PA, Rept. No. TM-80-32, 109 pp (Mar 6, 1980)
AD-A085 185/7

Key Words: Acoustic waves, Layered materials

The conversion efficiency of parametric amplification in fluids is low because of the low dispersivity. A discontinuous change in phase velocity at the boundary of a waveguide introduces dispersion, which in turn affects conversion efficiency. An analytical model is developed which may be used to numerically predict the conversion efficiency of a flatplate, acoustic waveguide given the physical parameters of the system.

81-388

Scattering of Elastic Waves by a Surface-Breaking Crack

D.A. Mendelsohn, J.D. Achenbach, and L.M. Keer

Halliburton Services, Chemical Res. Dept., Duncan, OK 73533, Wave Motion, 2 (3), pp 277-292 (Sept 1980) 11 figs, 5 refs

Key Words: Elastic waves, Wave diffraction, Cracked media

Scattering of incident surface waves and incident body waves by a surface-breaking crack is investigated in a two-dimensional geometry. By decomposing the scattered fields into symmetric and antisymmetric fields with respect to the plane of the crack, two boundary value problems for a quarter-plane are obtained.

81-389
Propagation of Love Waves Across a Vertical Discontinuity
B.G.Bukchin and A.L. Levshin
Inst. for Physics of the Earth, Academy of Science USSR, Moscow, USSR, Wave Motion, 2, pp 293-302 (1980) 8 figs, 24 refs

Key Words: Elastic waves, Wave propagation, Discontinuity-containing media

A new numerical approach is suggested for studying elastic surface-wave propagation across vertical discontinuities. Some computational results for Love wave propagation across the vertical boundary between two layered-quarter-spaces are demonstrated.

81-390
Assessment of Structural Effects in Acoustic Transient Experiments
R.L. Citerley, D.A. Kienholz, and W.C. Gibson
Anemet Laboratories, Inc., San Carlos, CA, ASME Paper No. 80-C2/PVP-122

Key Words: Interaction: structure-fluid, Acoustic excitation, Frequencies, Normal modes

Two methods are presented for simulating the wall pressure response of an acoustic fluid in a flexible container when a prescribed transient pressure is applied over a small portion of the fluid boundary.

81-391
Flow-Induced Tones in Side-Branch Pipe Resonators
M.L. Pollack
Knolls Atomic Power Lab., Schenectady, NY, Rept. No. KAPL-4124, 19 pp (Oct 1979), Presented at the Acoustical Soc. of Amer. Conf., Atlanta, GA, April, 1980

Key Words: Turbulence, Fluid-induced excitation, Acoustic response, Branched systems, Pipe resonators

Acoustic tones generated by turbulent flows and shear-layer-instability interactions with side-branch resonator pipes were investigated experimentally. The experimental values of resonant frequencies and instability frequencies were compared with predictions for two stages of shear-layer interaction.

81-392
The Electric Arc Furnace as a Noise Source
D.H. McQueen
Dept. of Bldg. Acoustics, Chalmers Univ. of Tech., 412 96 Göteborg, Sweden, Noise Control Engr., 15 (2), pp 89-95 (Sept/Oct 1980) 3 figs, 11 refs

Key Words: Industrial facilities, Noise generation, Noise reduction

In electric steelworks, the main noise sources are usually electric arc furnaces. An analytical study of two noise generation mechanisms, with possible means of noise reduction by sealing the furnaces, is summarized.

81-393
Attenuation Characteristics of Mufflers with Gas Reservoir in Liquid Pipe System (1st Report, The Effects of Axial Dimensions)
H. Narui and S. Inagaki
The Defense Academy, Yokosuka, Japan, Bull. JSME, 23 (182), pp 1374-1379 (Aug 1980) 8 figs, 9 refs

Key Words: Mufflers, Piping systems, Noise reduction

Attenuation of noise transmitted by way of water in water supply and water discharge systems in dwellings is discussed.

81-394
Application of Coherence Technique for Noise in Power Plants
S.P. Ying and E.E. Dennison
Gilbert/Commonwealth, Jackson, MI 49201, Noise Control Engr., 15 (2), pp 81-87 (Sept/Oct 1980) 14 figs, 11 refs

Key Words: Electric power plants, Noise generation, Coherence function technique

When total output power is simulated by statistically independent multiple sources through paths with linear behavior, the coherence function can be used to resolve the total power into individual output power for each source. This technique is applied to large electric power generating plants for identification and characterization of multiple noise sources inside the plants.

81-395
An Effective Noise Diagnosis Scheme for Industrial Plants
R. Elmaraghy and C.N. Baronet
Centre de Recherche Industrielle du Quebec, Quebec, Canada, S/V, Sound Vib., 14 (9), pp 14-18 (Sept 1980) 3 figs, 3 tables, 8 refs

Key Words: Industrial facilities, Noise generation

A comprehensive noise analysis program can provide an understanding of the overall noise problem in a plant before controls are implemented. Field measurements are performed in order to generate a plant noise matrix. Rank-ordering of machine noise sources, noise reduction priorities and noise reduction magnitudes required in the plant are established based on the workers' exposure index criteria. This information is used to develop an optimum noise control plan from an economical and technical standpoint.

81-396
The Contribution of Normal Modes in the Bottom to the Acoustic Field in the Ocean
M.K. Macpherson and G.V. Frisk
Woods Hole Oceanographic Institution, Woods Hole, MA 02543, J. Acoust. Soc. Amer., 68 (3), pp 929-940 (Sept 1980) 13 figs, 33 refs

Key Words: Underwater sound

The effects of normal modes in the bottom on the acoustic field in the ocean are examined. The ocean bottom model consists of a slow isovelocity layer overlying an isovelocity half-space to simulate the characteristic sound velocity drop at the water-bottom interface. Attention is focused on the perfectly trapped modes which are excited in the layer by inhomogeneous waves emitted by a point source in the water column. The relative normal mode contribution to the total acoustic field in the water is calculated analytically for a near-bottom source/receiver geometry and evaluated for representative ocean bottom examples.

SHOCK EXCITATION

(Also see Nos. 243, 244, 253, 260, 416, 467, 471)

81-397
Experimental Investigation of Three-Dimensional Shock Wave Turbulent Boundary Layer Interaction: An Exploratory Study of Blunt Fin-Induced Flows
D.S. Dolling and S.M. Bogdonoff
Dept. of Mechanical and Aerospace Engineering, Princeton Univ., NJ, Rept. No. MAE-1468, 75 pp (Mar 1980)
AD-A084 768/1

Key Words: Shock wave propagation, Boundary value problems

An experimental study of three-dimensional shock wave turbulent boundary layer interaction is carried out. Interactions generated by fin models having sharp and hemicylindrically blunted leading edges are studied.

81-398
Space-Time Elements for the Shock Wave Propagation Problem
A. Cella, M. Lucchesi, and G. Pasquinelli
C.N.R. c/o Istituto Scienza delle Costruzioni, Universita di Genova, Genova, Italy, Intl. J. Numer. Methods Engr., 15 (10), pp 1475-1488 (Oct 1980) 9 figs, 15 refs

Key Words: Shock wave propagation, Finite element technique

A space-time finite element procedure is presented that integrates on time the equations of nonlinear dynamics. When a shock occurs and subsequently propagates, the space-time procedure gives accurate and stable numerical results, without after-shock wiggling, at relatively low costs of computation.

81-399
The Uncoupling Criteria for Subsystem Seismic Analysis
C. Chen
Gilbert/Commonwealth Companies, Reading, PA 19603, Nucl. Engr. Des., 57 (2), pp 245-252 (May 1980) 8 figs, 12 refs

Key Words: Coupled systems, Seismic response, Equipment response, Nuclear power plants

The uncoupling effects of a subsystem from the system based on frequency, mode shape and response variations is discussed. The two-mass system is first used to study the problem, and a closed form solution of the frequency variation is derived for the two resonant masses with different mass ratios. Proper selection of modes for frequency variation check is also discussed.

81-400

Effects of Horizontally Travelling Waves in Soil-Structure Interaction

J.P. Wolf and P. Obernhuber

Electrowatt Engrg. Services, Ltd., CH-8022 Zurich, Switzerland, Nucl. Engr. Des., 57 (2), pp 221-244 (May 1980) 34 figs, 3 tables, 25 refs

Key Words: Interaction: soil-structure, Wave propagation, Nuclear power plants, Seismic response

Phenomena related to horizontally traveling waves are normally not considered in soil-structure interaction. Only vertically incident S- and P-waves are commonly assumed. To determine the influence of this very basic assumption, the responses of a massless basemat, a massless structure, a basemat with mass and a mass-spring system connected to a basemat with mass are parametrically analyzed for harmonic and transient excitations for all wave forms. Comparisons of the results of the same structures, calculated for the standard vertically incident body waves of the same amplitudes are made.

81-401

Dynamic Crack Propagation in Precracked Cylindrical Vessels Subjected to Shock Loading

C.H. Popelar, C. G[illegible]en, and M.F. Kanninen

Ohio State Univ., Columbus, OH, ASME Paper No. 80-C2/PVP-108

Key Words: Crack propagation, Shock response

Previous work has shown that a speed-independent dynamic fracture toughness property can be used in an elastodynamic analysis to describe crack initiation and unstable propagation under impact loading. In this paper, a further step is taken by extending the analysis from simple laboratory test specimens to treat more realistic crack-structure geometries.

81-402

Nonlinear Transient Analysis by Energy Minimization: A Theoretical Basis for the Action Computer Code

M.P. Kamat

Virginia Polytechnic Inst. and State Univ., Blacksburg, VA, Rept. No. NASA-CR-3287, 109 pp (July 1980)

N80-26697

Key Words: Crash research (aircraft), Nonlinear systems, Computer programs

The formulation basis for establishing the static or dynamic equilibrium configurations of finite element models of structures which may behave in the nonlinear range are provided. With both geometric and time independent material nonlinearities included, the development is restricted to simple one and two dimensional finite elements which are regarded as being the basic elements for modeling full aircraft-like structures under crash conditions.

81-403

Visco-Plastic and Large Deformation Analysis of Axial Symmetric Deformation of Thin-Walled Circular Tube

K. Murase and T. Nishimura

Faculty of Science and Engrg., Meijo Univ., Yagoto-Urayama Tenpaku Nagoya, Japan, Bull. JSME, 23 (182), pp 1297-1304 (Aug 1980) 20 figs, 11 refs

Key Words: Tubes, Cylindrical shells, Nonlinear systems, Impact response (mechanical), Finite element technique, Numerical analysis

A dynamic structural analysis involving material and geometrical non-linear characteristics is proposed and applied to a practical problem. This analysis is based on the finite element method and direct numerical integration, and can be used to predict the crushing behavior of various structures.

VIBRATION EXCITATION

(Also see Nos. 269, 425, 451, 476, 477)

81-404

Leading-Edge Flutter of Supercavitating Hydrofoils

C. Brennen, K.T. Oey, and C.D. Babcock

California Inst. of Tech., Pasadena, CA, J. Ship Res., 24 (3), pp 135-146 (Sept 1980) 16 figs, 2 tables, 27 refs

Key Words: Flutter, Leading edges, Hydrofoil craft

Results of experiments and analysis of the phenomenon of leading-edge flutter which has been observed to occur for supercavitating hydrofoils are presented.

81-405
Modal Dynamic Analysis of Linear Elastic Systems with Specified Displacement Time Histories
A.W. Chan, C.H. Chen, and B.J. Mitchel
Stone & Webster Engrg. Corp., Cherry Hill, NJ, ASME Paper No. 80-C2/PVP-91

Key Words: Modal analysis, Elastic media, Linear systems, Computer programs

A procedure for the dynamic analysis of linear elastic systems with specified displacement time histories at multiple support locations using the classical modal analysis computer programs without computer software modifications is presented. Based on the equations of motions, the exact procedure for modal dynamic analysis with displacement time-history inputs is shown equivalent to grounding all the dynamic degrees of freedom where displacements are specified and applying appropriate forcing functions to adjacent mass points.

81-406
An Application of the Poincare Map to the Stability of Nonlinear Normal Modes
L.A. Month and R.H. Rand
Dept. of Mech. Engrg., Univ. of California, Berkeley, CA 94720, J. Appl. Mech., Trans. ASME, 47 (3), pp 645-651 (Sept 1980) 9 figs, 1 table, 28 refs

Key Words: Normal modes, Periodic response, Nonlinear systems

The stability of periodic motions (nonlinear normal modes) in a nonlinear two-degree-of-freedom Hamiltonian system is studied by deriving an approximation for the Poincaré map via the Birkhoff-Gustavson canonical transformation. This method is presented as an alternative to the usual linearized stability analysis based on Floquet theory.

81-407
Localized Response Reductions in Wide-Band Random Vibration of Uniform Structures
S.H. Crandall
Ford Professor of Engrg., Massachusetts Inst. of Tech., Cambridge, MA 02139, Ing. Arch., 49 (5/6), pp 347-359 (1980) 11 figs, 10 refs

Key Words: Random excitation, Damped structures

When a lightly damped uniform structure is excited by a broad band random source, there is a tendency for the mean-square velocity to be uniformly distributed over the structure as the number of responding modes increases. Localized zones or lanes of intensified response have been noted in one-dimensional and certain symmetrical two-dimensional structures. It is shown that under some circumstances there can also be localized zones or lanes of reduced response.

81-408
A Symmetric Modal Formulation of Fluid-Structure Interaction, Including a Static Approximation to Higher Order Fluid Modes
R.H. MacNeal, R. Citerley, and M. Chargin
The MacNeal-Schwendler Corp., Los Angeles, CA, ASME Paper No. 80-C2/PVP-116

Key Words: Interaction: structure-fluid, Finite element technique

A method of fluid-structure coupling is described which results in symmetrical matrix equations of standard form that can be solved efficiently by existing finite element computer programs. The method requires that the uncoupled vibration modes of either the fluid or the structure be computed prior to the coupled analysis.

81-409
Non-Stationary Resonance Vibrations of Non-Linear Systems with Many Degrees of Freedom and with Many Non-Linearities in Flexible Constraints (Nestacionární rezonanční kmity nelineárních soustav s více stupni volnosti a s více nelinearitami v pružných vazbách)
J. Brynich
ŠKODA Plzen Central Res. Inst., Czechoslovakia, Strojnický Časopis, 31 (2), pp 121-139 (1980) 13 figs, 3 refs
(In Czech)

Key Words: Asymptotic series, Resonance pass through, Nonlinear systems, Multidegree of freedom systems

Non-stationary vibrations of non-linear systems arising during a uniform overtravel of the main resonance regions are analyzed in an asymptotic metnod. The external force excitation is formed by a single frequency complex vector with a slow linear change in frequency and with constant amplitudes. The non-linear system is considered in the form of a simple chain with non-linearities in flexible constraints.

81-410
A Dynamic Model of a System with Viscoelastic Restoring Force (Náhradni dynamický model systému s viskoelastickou vratnou silou)

A. Tondl
National Res. Inst. for Machine Design, Praha-Bechovice, Czechoslovakia, Strojnicky Časopis, 31 (2), pp 141-146 (1980) 2 figs, 1 ref
(In Czech)

Key Words: Nonlinear theories, Harmonic excitation, Single degree of freedom systems

Some elastic elements show a difference between the static and dynamic restoring force characteristic. A mathematical model of a system consisting of such an elastic element with one mass excited by a harmonic force is presented and analyzed.

81-411
The Null Dynamical Effect, and Some Frequency Spectra, of Resonant Inertial Pressure Waves in a Rapidly Rotating, Right Circular, Sectored Cylinder

W.E. Scott
Univ. of Tennessee and the Ballistic Res. Labs., Knoxville, TN 37916, J. Appl. Mech., Trans. ASME, 47 (3), pp 475-481 (Sept 1980) 9 figs, 1 table, 20 refs

Key Words: Resonant frequencies, Interaction: structure-fluid, Fluid-filled containers, Rotating structures, Spacecraft

It is shown that inertial waves in the form of standing asymmetrical pressure waves can exist in an incompressible liquid in a rotating sectored cylinder in a rigid body executing a small amplitude gyroscopic motion about its center of mass. Some of the frequency spectra of these waves are presented along with the result that sectoring the cylinder into any number of equal sectors results in eliminating the destabilizing effect of these waves when there is a "Stewartson" resonance between the frequency of one of the inertial modes and the frequency of the nutational component of the motion of the container.

81-412
Harmonic Viscoelastic Waves Propagating Parallel to the Layers of Laminated Media

K. Tanaka and A. Kon-no
Faculty of Engrg., Kyoto Univ., Kyoto, Japan, Bull. JSME, 23 (181), pp 1100-1108 (July 1980) 9 figs, 22 refs

Key Words: Composite materials, Layered materials, Wave propagation, Viscoelastic media, Harmonic excitation

The propagation of harmonic viscoelastic waves in laminated media is analyzed. The frequency equations are formulated for various wave modes propagating in the direction parallel to the layers of viscoelastic laminated media. The frequency-complex wave number spectra are obtained for the waves in an alternate laminated composite which consists of elastic reinforcing layers and viscoelastic matrix layers. The phase velocity and the attenuation on the lowest branch are investigated in the range of low frequencies.

81-413
Harmonic Wave Propagation in a Periodically Layered, Infinite Elastic Body: Plane Strain, Numerical Results

T.J. Delph, G. Herrmann, and R.K. Kaul
Div. of Appl. Mechanics, Stanford Univ., Stanford, CA 94305, J. Appl. Mech., Trans. ASME, 47 (3), pp 531-537 (Sept 1980) 15 figs, 5 refs

Key Words: Layered materials, Wave propagation, Elastic media, Harmonic excitation

Numerical results are presented for the dispersion spectrum for harmonic wave propagation in an unbounded, periodically layered elastic body in a state of plane strain. Both real and complex branches are considered.

81-414
Harmonic Viscoelastic Waves Propagating Normal to the Layers of Laminated Media

K. Tanaka and A. Kon-no
Faculty of Engrg., Kyoto Univ., Kyoto, Japan, Bull. JSME, 23 (181), pp 1092-1099 (July 1980) 5 figs, 18 refs

Key Words: Composite materials, Layered materials, Wave propagation, Harmonic excitation, Viscoelastic media

The propagation of the harmonic viscoelastic waves in the laminated media in the direction normal to the layers is analyzed, and the frequency equations for the dilatational waves and the shear waves are formulated. The frequency-complex wave number spectra are obtained for the laminated

composites which consist of elastic reinforcing layers and viscoelastic matrix layers. The phase velocity spectra and the attenuation spectra are investigated in the range of low frequencies.

81-415
Flutter Analysis of Missile Control Surfaces Containing Structural Nonlinearities
R.M. Laurenson and R.M. Trn
McDonnell Douglas Astronautics Co., St. Louis, MO, AIAA J., 18 (10), pp 1245-1251 (Oct 1980) 10 figs, 9 refs

Key Words: Flutter, Missiles, Nonlinear systems

Missile control surfaces often contain nonlinearities which affect their performance characteristics and flutter boundaries. Analysis techniques accounting for these nonlinearities are discussed along with their application to the investigation of the dynamics of missile control surfaces containing structural freeplay-type nonlinearities.

81-416
Commonality of Earthquake and Wind Analysis
P.J. Cevallos-Candau
Dept. of Civil Engrg., Illinois Univ. at Urbana-Champaign, IL, Rept. No. STRUCTURAL RESEARCH SER-472, UILU-ENG-80-2002, NSF/RA-800022, 210 pp (Jan 1980)
PB80-178312

Key Words: Wind-induced excitation, Seismic excitation, Random vibration, Response spectra

The common features of general dynamic analysis procedures employed for evaluating the effects of wind and earthquake excitation are investigated. A major goal is to investigate and develop a basis for generating response spectra for wind loading, which in turn would permit the use of modal analysis techniques for wind analysis in a manner similar to that employed for earthquake engineering.

81-417
Steady, Oscillatory, and Unsteady Subsonic and Supersonic Aerodynamics, Production Version (SOUSSA-P 1.1) Volume 1: Theoretical Manual
L. Morino
Aerospace Systems, Inc., Burlington, MA, Rept. No. NASA-CR-159130; ASI-TR-78-45-VOL-1, 134 pp (Jan 1980)
N80-26269

Key Words: Computer programs, Aerodynamic characteristics, Natural frequencies, Mode shapes

Recent developments of the Green's function method and the computer program SOUSSA (Steady, Oscillatory, and Unsteady Subsonic and Supersonic Aerodynamics) are reviewed and summarized.

81-418
Determination of Hydrodynamic Mass Using a General Purpose Finite Element Structural Code
I.-W. Yu
Westinghouse R & D Ctr., Pittsburgh, PA, ASME Paper No. 80-C2/PVP-117

Key Words: Computer programs, Hydrodynamic excitation, Interaction: structure-fluid, Finite element technique

A computational technique using a general purpose finite element structural code in determining the hydrodynamic mass of a fluid-structure system is introduced.

MECHANICAL PROPERTIES

DAMPING

(Also see Nos. 302, 348, 480)

81-419
Subharmonic Steady Vibrations of a Non-Linear Damper with Two Degrees of Freedom and Viscous Damping
R. Riganti
Istituto di Meccanica Razionale, Politecnico di Torino, Turin, Italy, Intl. J. Nonlin. Mech., 15 (3), pp 173-183 (1980) 7 figs, 16 refs

Key Words: Dampers, Dynamic vibration absorption (equipment), Viscous damping

The steady-state, 1/3 subharmonic vibrations of a dynamic damper with two degrees of freedom, sinusoidal forcing function and internal viscous damping, are presented.

81-420

Active Damping of Modal Vibrations by Force Apportioning

W.L. Hallauer, Jr.
Dept. of Aerospace and Ocean Engrg., Virginia Polytechnic Inst. and State Univ., Blacksburg, VA, Rept. No. NASA-CR-163396, 48 pp (June 1980)
N80-28372

Key Words: Active damping, Force apportioning method, Computer programs

Force apportioning, a method of active structural damping based on that used in modal vibration testing of isolating modes by multiple shaker excitation is analyzed and numerically simulated. The computer programs developed are described and possible refinements of the research are examined.

81-421

Gyrodampers for Large Space Structures

J.N. Aubrun and G. Margulies
Lockheed Aircraft Corp., Palo Alto, CA, Rept. No. NASA-CR-159171, 107 pp (Feb 1979)
N80-28417

Key Words: Gyroscopes, Dampers, Spacecraft

The problem of controlling the vibrations of large space structures by the use of actively augmented damping devices distributed throughout the structure is addressed. The gyrodamper which consists of a set of single gimbal control moment gyros which are actively controlled to extract the structural vibratory energy through the local rotational deformations of the structure, is described and analyzed.

81-422

Verification of Limit Envelopes Method for Damping Identification (Ověření metody limitních obalek pro identifikaci tlumení)

J. Svačina and V. Fiala
National Res. Inst. for Machine Design, Praha-Bechovice, CSSR, Strojnicky Časopis, 31 (3), pp 319-330 (1980) 6 figs, 3 refs
(In Czech)

Key Words: Limit analysis, Parameter identification technique, Damping coefficients

The shape of the s.c. limit envelopes depends on the character of damping and exciting forces. Application of limit envelopes for damping identification is proposed and agreement between analytical solution and analog simulation is presented.

81-423

Critical Damping in Linear Discrete Dynamic Systems

D.E. Beskos and B.A. Boley
Univ. of Minnesota, Minneapolis, MN 55455, J. Appl. Mech., Trans. ASME, 47 (3), pp 627-630 (Sept 1980) 3 figs, 2 refs

Key Words: Critical damping, Linear systems, Viscous damping

Free viscously damped vibrations of linear discrete systems are studied. A general method is developed for determining the critical damping surfaces of a system. Three examples presented in detail illustrate the proposed technique and some of the important characteristics of critical damping surfaces.

81-424

Some Aspects of Fluid-Structure Coupling with the Implicit Continuous Eulerian Hydrodynamics Algorithm

A.V. Jones
Joint Research Centre-Ispra Establishment, Ispar (Va), Italy, ASME Paper No. 80-C2/PVP-101

Key Words: Interaction: structure-fluid, Algorithms, Damping effects

The ICE algorithm is widely used in fluid-structure problems but is thought by some to produce unacceptable numerical damping. An evaluation is made of the damping of each eigenmode both in ICE alone and in ICE coupled to a very simple structure in the acoustic approximation.

81-425
Some Resonance Properties of a System with Multilinear Hysteresis (Niektoré rezonančné vlastnosti sústav s multilineárnou hysteréziou)
J. Murin
Inst. of Machine Mechanics of the Slovak Academy of Sciences, Dubravska cesta, 809 31 Bratislava, Czechoslovakia, Strojnicky Časopis, 31 (2), pp 147-156 (1980) 4 figs, 4 refs
(In Slovak)

Key Words: Coulomb friction, Resonant response, Hysteretic damping

The effect of dry friction magnitude upon the resonance dynamical magnification factor of a mechanical system whose stiffness and damping properties may be expressed by the so called multilinear centrally symmetrical hysteresis loop is presented.

FATIGUE

(See Nos. 236, 237, 238, 258, 285, 327, 437, 438, 470, 481)

ELASTICITY AND PLASTICITY

81-426
Identification of the Elastic Characteristics of Composite Materials by Means of Vibration Tests and a Model of Discrete Conservative Calculation
D. Engrand and D. Louis
Office National d'Etudes et de Recherches Aerospatiales, Paris, France, ESA-TT-632, pp 79-90, 1979 (Engl. transl. of La Rech. Aerospatiale, Bull. Bimestriel, Paris, no 1979-6, pp 401-409, Nov/Dec 1979)
N80-26261

Key Words: Composite materials, Elastic properties, Vibration tests, Shells, Cylindrical shells

A method for determining the elastic properties necessary to define a truly representative calculation model of a composite structure is proposed. The method consists of defining, in terms of stiffness, the difference between a preliminary computation and experimentally determined eigenmodes, and then iteratively minimizing this difference in elasticity coefficients by adjusting the calculation model.

81-427
Random Response of a Rigid Sphere Embedded in a Viscoelastic Medium and Related Problems
A.I. Beltzer
Holon Center for Technological Education, 52 Golomb St., P.O. Box 305, Holon, Israel, J. Appl. Mech., Trans. ASME, 47 (3), pp 499-503 (Sept 1980) 6 figs, 28 refs

Key Words: Spheres, Viscoelastic media, Random response, Harmonic response

Random and harmonic responses are considered for a rigid movable sphere embedded in a viscoelastic medium. The solution takes into account the filtering effect of the viscoelastic medium on the traveling random waves. Results obtained are applicable to the prediction of mechanical properties of composite materials, as well as to those of buried structures, when these objects are excited by incompletely known or random disturbances.

EXPERIMENTATION

MEASUREMENT AND ANALYSIS

(Also see No. 303)

81-428
Calculation of Frequency Response by Means of Programmable Pocket Calculators (Das Berechnen von Frequenzgangen mit Taschenrechnerprogrammen)
P. Vaske
Fachhochschule Hamburg, Hamburg, Germany, Feinwerktechnik & Messtechnik, 88 (6), pp 316-319 (Sept 1980) 9 figs, 1 table, 11 refs
(In German)

Key Words: Computer programs, Frequency response, Measurement techniques

Four examples are presented which illustrate how to obtain frequency responses of instruments, circuits and other systems used in measurement and control technology by means of programmable pocket calculators. The program enables to compute Nyquist or Bode plots of filters from the transfer function of the system and to investigate the effects of tolerances of the components used.

81-429

Computer-Aided Vibration Analysis by Means of Fourier Transform. Part 1: Fundamentals, Computer Hardware and Digital Filters (Rechnergestutzte Schwingungsanalyse mit Hilfe der Fourier-Transformation. Teil 1: Grundlagen, Rechner-Hardware und digitale Filter)

E. Gossmann and H. Waller

VDI-Z., 122 (11), pp 431-437 (June 1980) 13 figs, 7 refs

(In German)

Key Words: Vibration response, Fourier transformation, Digital filters

An introduction to vibration theory and the application of Fourier transformation and digital filters in vibration analysis is presented.

81-430

Computer-Aided Vibration Analysis by Means of Fourier Transform. Part 2: Spectrum Analysis, Random Vibrations and Examples (Rechnergestutzte Schwingungsanalyse mit Hilfe der Fourier-Transformation. Teil 2: Spektralanalyse, Zufallsschwingungen und Beispiele)

E. Gossmann and H. Waller

VDI-Z., 122 (12), pp 477-481 (June 1980) 11 figs, 1 table

(In German)

Key Words: Vibration response, Fourier transformation

The determination of mechanical properties of machines by means of Fourier transform is illustrated. Other applications of the method are also described.

81-431

On Energy Balance in the Dynamics of Systems with Time-Dependent Constraints

V. Nicolae and V. Chiroio

Inst. for Physics and Material Tech., Bucharest, Rev. Roumaine Sci. Tech., Mecanique, 25 (2), pp 237-242 (Mar/Apr 1980) 1 fig, 5 refs

Key Words: Time dependent parameters, Dynamic structural analysis

Energy balance in the dynamics of systems subjected to time-dependent constraints is analyzed. Lagrangian equations are completed by the energetical equation that assures the energy balance. These equations are applied to the motion of the system in the potential and dissipative field and are illustrated by an example.

81-432

Frequency Tracked Pulse Technique for Ultrasonic Analysis

J.H. Cantrell and J.S. Heyman

NASA Langley Res. Ctr., Langley Station, VA, PAT-APPL-6-158 183, 21 pp (June 1980)

Key Words: Spectrum analyzers, Testing techniques

A tracking generator is slaved to a spectrum analyzer to produce an input signal having a frequency that follows the frequency of the spectrum analyzer sweeping local oscillator. The input signal is gated to a transducer by a transmitter gate to produce ultrasonic waves in the sample.

81-433

A Parametric Transducer for the Detection of Small Displacements (Trasduttore Parametrico Per la Rivelazione di Piccoli Spostamenti)

F. Bordoni

Laboratorio di Ricerca e Technologia per lo Studio del Plasma nello Spazio, Frascati, Italy, Rept. No. LPS-79-3, 17 pp (Mar 1979)

N80-24568

(In Italian)

Key Words: Displacement transducers, Antennas

A parametric transducer used for the detection of vibrations in a gravitational antenna is described. Several noise sources are examined in detail, comparing the noise sensitivity of the described transducer with previously described transducers.

81-434

Surface Displacement Measurements, Strain and Vibrational Analysis Using Speckle Metrology Techniques

A.B. Lerchbacker

Naval Postgraduate School, Monterey, CA, 154 pp (Mar 1980)

Key Words: Plates, Rectangular plates, Speckle metrology techniques, Vibration analyzers, Displacement measurement

Double-exposure specklegrams were made of aluminum 2024-T4 rectangular plates. The double-exposure speckle technique was applied to the aluminum plate to measure in-plane translation and rotation and out-of-plane tilt. Strain and vibrational analyses were also conducted. The vibrational results were compared with results previously obtained using double-exposure time average holography.

81-435

The Rotating Beam Gyroscope

C.H.J. Fox and J.S. Burdess

Dept. of Mech. Engrg., Nottingham Univ., Nottingham NG7 2RD, UK, J. Appl. Mech., Trans. ASME, 47 (3), pp 631-637 (Sept 1980) 8 figs, 5 refs

Key Words: Measuring instruments, Displacement measurement, Accelerometers, Gyroscopes

The dynamics of a novel multisensor comprising a two-axis gyroscope and a single-axis linear accelerometer are investigated. The theoretical analysis indicates that the gyroscope has two modes of operation, untuned and tuned, offering, respectively, angular rate and angular displacement measurement capability, depending on the damping and mistuning present.

81-436

Analysis of a Transient Load Measuring System

R.R. Good and T.R. Meachum

EG and G. Idaho, Inc., Idaho Falls, Presented at the 26th International Instrumentation Symp., Seattle, WA, May 5, 1980, 11 pp (1980)

CONF-800502-5

Key Words: Measuring instruments, Transient response

An analysis of the performance of a load measuring system is presented. The load system was designed to measure the weight of a pressure vessel containing high pressure and temperature water. The uncertainty and frequency response of the system are quantified for both steady state and dynamic conditions.

DYNAMIC TESTS

81-437

Harmonic Excitation of Mechanical Systems at High Frequencies and Large Accelerators

H. Loiseau

Office National d'Etudes et de Recherches Aerospatiales, Paris, France, ESA-TT-613, pp 79-84, 1979 (Engl. transl. of La Rech Aerospatiale, Bull. Bimestriel, Paris, no. 1979-5, pp 345-348, Sept/Oct 1979)

N80-25491

Key Words: Fatigue tests, Test equipment and instrumentation, Harmonic excitation

A structure may be excited for fatigue tests at high frequencies and amplitudes by a conventional electrodynamic exciter. The structure and the exciter are connected by a mechanical device designed to resonate at the excitation frequency.

81-438

Digital Control of Multichannel Fatigue Testing Systems for the Automotive Industry (Digitale Regelung von Mehrkomponenten-Betriebsfestigkeitsprüfstanden fur die Automobilindustrie)

F. Klinger

Bismarckstrasse 59A, 1000 Berlin, 39 Germany, Automobiltech. Z., 82 (9), pp 469-474 (Sept 1980) 10 figs, 7 refs

Key Words: Fatigue tests, Test facilities, Automated testing

To improve the analog control of servo-hydraulic fatigue test rigs, a new digital concept has been developed which uses high-speed digital computers and array-processors to calculate all transfer functions of the system and then to produce drive signals for up to 16 actuators.

81-439

Development of a Taped Random Vibration Technique for Acceptance Testing

G. Hirschberger, J.J. Popolo, J. Devitt, and R. Pokallus

Grumman Aerospace Corp., Bethpage, NY, J. Environ. Sci., 23 (5), pp 11-14 (Sept/Oct 1980) 5 figs, 2 tables

Key Words: Vibration tests, Random vibration, Vibration generation, Testing techniques

Results of a study to develop an economical technique for generating random vibration are described.

81-440

A Feasibility Study of Detecting Reinforcing-Bar Debonding by Acoustic-Emission Technique

A.S. Kobayashi, N.M. Hawkins, Y-L A. Chan, and I-J. Lin

Univ. of Washington, Seattle, WA 98195, Exptl. Mech., 20 (9), pp 301-308 (Sept 1980) 10 figs, 15 refs

Key Words: Nondestructive tests, Acoustic emission, Reinforced concrete, Cyclic loading

Acoustic emissions detected by two transducers mounted on a reinforcing bar in a reinforced-concrete block, which is subjected to cyclic tension-compression loading, are used to assess the locations of re-bar debonding.

81-441

Nondestructive Evaluation of Airport Pavements. Volume 3: Operation Manual for MLGPAV Program at TCC

D. Yang

Yang (Nai C.) and Associates, New York, NY, Rept. No. AD-A079591; FAA-RD-78-154-Vol-3, 47 pp (Sept 1979)

N80-26331

Key Words: Nondestructive tests, Airports, Pavements, Interaction: wheel-pavement

Sensitivity analysis of aircraft parameters on functional pavement design is discussed. The MLGPAV program is an integrated system which is data independent based on defined mathematical models and operational logic. The input data is divided into job and universal default inputs.

DIAGNOSTICS

81-442

Acoustic Emission Arising from Plastic Deformation and Fracture

K. Ono

Dept. of Materials, California Univ., Los Angeles, CA, Rept. No. TR-80-02, 42 pp (May 1980), Presented at the Joint Meeting of ASA and ASJ, special session on Acoustic Emission, Honolulu, HI, Dec 1, 1978

AD-A086 263/1

Key Words: Acoustic emission, Diagnostic techniques

Current status of acoustic emission signal detection methods, theoretical analysis of acoustic emission sources and acoustic emission behavior of materials arising from plastic deformation and fracture are reviewed. Recent developments in quantitative signal detection and transducer characterization are considered. Several theories of acoustic emission sources are summarized.

81-443

Practical Application of Taped Random Screening Using Digital Vibration Control Systems

D.A. Mahn

Dynamic Systems Div., Thermotron Industries, Holland, MI, J. Environ. Sci., 23 (5), pp 15-17 (Sept/Oct 1980) 3 figs, 4 refs

Key Words: Diagnostic techniques, Random vibration

With improved commercial audio record/playback systems, cassette-taped random provides the avionics and commercial industries with a practical and cost effective means of implementing a random vibration screening program.

81-444

Progress Toward Acoustic Emission Characterization for Continuous Monitoring Reactor Pressure Vessels

P.H. Hutton, E.B. Schnenk, and R.J. Kurtz

Battelle Pacific Northwest Labs., Richland, WA, Rept. No. PNL-SA-7746; CONF-7909132-1, 7 pp (1979), Presented at the International Symp. on Methods of Nondestructive Testing of Mater. and Their Appl. in Nucl. Engr., Saarbrucken, West Germany, Sept 17, 1979

N80-28760

Key Words: Diagnostic techniques, Nuclear reactor components, Pressure vessels, Crack detection, Acoustic emission

The feasibility of detecting and analyzing flaw growth in an operating reactor vessel using acoustic emission data is evaluated. A preliminary AE flaw growth relationship was developed encompassing six variables.

BALANCING

81-445

Experimental Investigation of Multi-Span Rotor Balancing Using Least Squares Method

F. Fujisawa, K. Shiohato, K. Sato, T. Imai, and E. Shoyama

Hitachi Res. Lab., Hitachi, Ltd., Japan, J. Mech. Des., Trans. ASME, 102 (3), pp 589-596 (July 1980) 10 figs, 3 tables, 10 refs

Key Words: Balancing techniques, Rotors (machine elements), Least squares method

The least-squares method which uses influence coefficients was applied to simultaneous balancing of a multibearing rotating shaft system, and an experiment was conducted to demonstrate its effectiveness.

MONITORING

81-446

Vibration Monitoring for Rotating Machinery

I.R. Hitchen

Manager Instruments, U.K.F. Fertilisers Ltd., Measurement and Control, 13 (3), pp 97-102 (Mar 1980) 9 figs

Key Words: Vibration monitoring, Vibration probes, Accelerometers

A guide for instrument personnel involved in specifying and/or maintaining vibration monitoring equipment is presented.

81-447

Holographic and Acoustic Emission Evaluation of Pressure Vessels

D.M. Boyd

Lawrence Livermore Lab., Livermore, CA, ASME Paper No. 80-C2/PVP-25

Key Words: Monitoring techniques, Pressure vessels, Holographic techniques, Interferometric techniques, Acoustic emission

Optical holographic interferometry and acoustic emission monitoring were simultaneously used to evaluate two small, high pressure vessels during pressurization. The techniques provide pressure vessel designers with both quantitative information such as displacement/strain measurements and qualitative information such as flaw detection.

81-448

Progress in Vibration Analysis Technology

R.J. Kiefer

Spectral Dynamics, Subs. Scientific-Atlanta, San Diego, CA, Power Transm. Des., pp 108-112 (Oct 1980) 9 figs, 1 table

Key Words: Monitoring techniques, Design techniques, Rotating structures, Spectrum analysis

The discussion focuses on frequency spectrum measurements for identifying maintenance problems, and on resonance identification by mode shape analysis to assist in product design.

81-449

Modeling of Elastoplastic Fracture Behavior Using Acoustic Emission Methods

R.S. Williams

United Technologies Res. Ctr., East Hartford, CT, Closed Loop, 10 (2), pp 15-23 (Oct 1980) 10 figs, 3 tables, 6 refs

Key Words: Monitoring techniques, Acoustic emission, Fracture properties

Acoustic emission monitoring of pressure vessels is receiving increased attention by government agencies, code committees and utilities as a viable technique for preservice (hydrotest) and in-service inspection. Results of a series of compact tension fracture tests, heat treated to exhibit a range of fracture behavior monitored with acoustic emission, are presented. A theoretical model is developed and several schemes for acoustic emission source classification are discussed.

ANALYSIS AND DESIGN

ANALOGS AND ANALOG COMPUTATION

81-450
On the Dynamics of Plates Using a Beam-Analog
M.E. Mohsin and E.A. Sadek
Aeronautical Dept., Cairo Univ., Giza, Egypt, Computers Struc., 42 (3), pp 267-272 (Sept 1980) 7 figs, 3 tables, 19 refs

Key Words: Analog simulation, Plates, Beams

A beam-analog element which simulates both the static and dynamic behavior of plates, with or without in-plane forces, using the same routine program is described. Typical examples of plate dynamics are used to demonstrate the accuracy and convergency of the analog.

ANALYTICAL METHODS
(Also see Nos. 409, 422)

81-451
Direct Method of Determination of Self Oscillation of Thin-Walled Prismatic Elements (Priama metóda určovania vlastných kmitov tenkostenných prizmatických prvkov)
F. Šimčak
Mechanical Engr. of the Technical University Kosice, CSSR, Strojnicky Časopis, 31 (1), pp 75-88 (1980) 7 figs, 9 refs
(In Slovak)

Key Words: Direct computational method, Prismatic bodies, Oscillation, Beams

A method of determination of self oscillation and shape of self oscillation of thin-walled prismatic elements is presented.

81-452
Notes on Accuracy of Approximate Solutions of Systems with Parametric Excitation
T. Kotera
Dept. of Production Engrg., Faculty of Engrg., Kobe Univ., Rokko-dai 1, Nada, Kobe 657, Japan, Stojnicky Časopis, 31 (3), pp 251-267 (1980) 5 figs, 34 refs

Key Words: Parametric excitation, Perturbation theory

Vibrations of systems with parametric excitations have been extensively investigated by many researchers. In most works, vibrations are analyzed by the perturbation method rather than by a mathematically exact method. In such works that introduce the correct characteristic equations for systems with parametric excitations, rational methods of determining characteristic roots are not shown explicitly nor is accuracy of the results by the perturbation method shown.

81-453
Penalty Methods in Finite Element Analysis of Fluids and Structures
D.S. Malkus
Dept. of Mathematics, Ill. Inst. of Tech., Chicago, IL 60616, Nucl. Engr. Des., 57 (2), pp 441-448 (May 1980) 3 figs, 4 tables, 11 refs

Key Words: Finite element technique, Galerkin method, Penalty technique

The use of penalty techniques in finite element Galerkin equations is discussed.

81-454
Comparison of Variational and Finite Element Solutions of Helmholtz's Equation
P.A.A. Laura, R.H. Gutierrez, and G.S. Sarmiento
Inst. of Applied Mechanics, Base Naval Puerto Belgrano, Argentina and Centro Atomico Bariloche (CNEA), Rio Negro, Argentina, J. Acoust. Soc. Amer., 68 (4), pp 1160-1162 (Oct 1980) 2 figs, 2 tables, 9 refs

Key Words: Natural frequencies, Membranes (structural members), Variational methods, Finite element technique

Some numerical experiments on the determination of natural frequencies of vibration of doubly connected membranes of complicated boundary shape are presented. Finite element results are compared with values obtained using an approximate method.

81-455
Study of Fracture Dynamics by the Finite Element Method (Studium dynamiky trhlin metodou konečných prvků)
Z. Bílek
Inst. of Physical Metallurgy, Brno, Czechoslovakia, Strojnicky Časopis, 31 (1), pp 33-44 (1980) 10 figs, 32 refs
(In Czech)

Key Words: Finite element technique, Fracture properties

The application of a finite element computer program in dynamic fracture mechanics is presented. Standard isoparametric elements are employed for spatial discretization with an explicit central difference time integration scheme.

81-456
Eigenvalues for Unstable Resonators with Slightly Misaligned Strip Mirrors
C. Santana and L.B. Felsen
Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil, Rept. No. INPE-1738-RPE/137-Rev, 17 pp (May 1980)
N80-26140

Key Words: Eigenvalue problems

Very small misalignments in unstable strip resonators may cause detachment of the low loss eigenmode at lower equivalent Fresnel number, N sub eq, and introduce different periodicities into the eigenvalue curve as a function of N sub eq. Using the resonance equation developed previously from waveguide mode theory, this behavior is explained in physical terms by coupling between mode fields with even and odd symmetry, which are uncoupled in the perfectly aligned configuration.

81-457
Numerical Bracketing of the Eigenvalues of Complex Linear Structures
P. Gibert
Office National d'Etudes et de Recherches Aerospatiales, Paris, France, ESA-TT-632, pp 69-78, 1979 (Engl. transl. of La Rech. Aerospatiale, Bull. Bimestriel Paris, no. 1979-6, Nov/Dec 1979, pp 395-400)
N80-26260

Key Words: Eigenvalue problems, Linear systems

Consideration is given to the numerical bracketing of the eigenvalues of a symmetrical operator associated with elliptical partial differential equations for the case of a complex linear structure. A method for solving a supplemental static problem by means of a mixed variational formulation is presented.

MODELING TECHNIQUES
(Also see Nos. 223, 229, 266, 270, 305)

81-458
The Stochastic Finite-Element Method
H. Contreras
EESCO Energy Services, San Francisco, CA 94111, Computers Struc., 42 (3), pp 341-348 (Sept 1980) 4 figs, 3 tables, 29 refs

Key Words: Mathematical models, Finite element technique, Stochastic processes

A generic stochastic finite-element method for modeling structures is proposed as a means to analyze and design structures in a probabilistic framework. Stochastic differential and difference equation theory is applied in structures discretized with the finite-element methodology.

81-459
Numerical Modeling of Dynamic Crack Propagation in Finite Bodies, by Moving Singular Elements. Part 1: Formulation
T. Nishioka and S.N. Atluri
School of Civil Engrg., Georgia Inst. of Tech., Atlanta, GA 30332, J. Appl. Mech., Trans. ASME, 47 (3), pp 570-596 (Sept 1980) 2 figs, 12 refs

Key Words: Crack propagation, Finite element technique

An efficient numerical (finite-element) method is presented for the dynamic analysis of rapidly propagating cracks in finite bodies, of arbitrary shape, wherein linear-elastic material behavior and two-dimensional conditions prevail. Procedures to embed analytical asymptotic solutions for singularities in stresses/strains near the propagating crack-tip, to

account for the spatial movement of these singularities along with the crack-tip, and to directly compute the dynamic stress-intensity factor, are presented.

81-460

Numerical Modeling of Dynamic Crack Propagation in Finite Bodies, by Moving Singular Elements. Part 2: Results

T. Nishioka and S.N. Atluri

School of Civil Engrg., Georgia Inst. of Tech., Atlanta, GA, J. Appl. Mech., Trans. ASME, 47 (3), pp 577-582 (Sept 1980) 11 figs, 14 refs

Key Words: Crack propagation, Finite element technique

Using the moving-singularity finite-element method, several problems of dynamic crack propagation in finite bodies have been analyzed. Discussions of the effects of wave interactions on the dynamic stress-intensity factors are presented. The obtained numerical results are compared with the corresponding infinite domain solutions and other available numerical solutions for finite domains.

81-461

Modal Cost Analysis for Linear Matrix-Second-Order Systems

R.E. Skelton and P.C. Hughes

School of Aeronautics & Astronautics, Purdue Univ., West Lafayette, IN 47907, J. Dyn. Syst., Meas. and Control, Trans. ASME, 102 (3), pp 151-158 (Sept 1980)

Key Words: Modal analysis, Mathematical models

Reduced models and reduced controllers for systems governed by matrix-second-order differential equations are obtained by retaining those modes which make the largest contributions to quadratic control objectives. Such contributions, when used as mode truncation criteria, allow the statement of the specific control objectives to influence the early model reduction from very high order models which are available, for example, from finite element methods. The relative importance of damping, frequency and eigenvector in the mode truncation decisions are made explicit for each of these control objectives: attitude control, vibration suppression and figure control.

81-462

Dynamical Models for Multidimensional Structures Using Bond Graphs

D.L. Margolis

Dept. of Mech. Engrg., Univ. of California, Davis, CA 95616, J. Dyn. Syst., Meas. and Control, Trans. ASME, 102 (3), pp 180-187 (Sept 1980) 9 figs, 2 tables, 8 refs

Key Words: Mathematical models, Bond graph technique

Bond graphs are used to construct finite mode, long wavelength models of multidimensional structures. These structures are, in some cases, either too large or constructed from so many physical pieces that complete modeling using finite element methods is prohibited. Bond graph development for this type of dynamic system is given.

NONLINEAR ANALYSIS

81-463

A Modified Volterra Series Representation for a Class of Single-Valued, Continuous Nonlinear Systems

G.A. Parker and E.L. Moore

Dept. of Mech. Engrg., Univ. of Surrey, Guildford CU2 5XH, UK, J. Dyn. Syst., Meas. and Control, Trans. ASME, 102 (3), pp 163-167 (Sept 1980) 4 figs, 20 refs

Key Words: Nonlinear theories, Functional analysis, System identification techniques, Cross correlation technique

A modification is presented to the Volterra functional series representation of the response from a cascaded linear-nonlinear-linear system in which the nonlinear element is single-valued, separable, and continuous.

NUMERICAL METHODS

(See Nos. 459, 460)

PARAMETER IDENTIFICATION

(Also see No. 316)

81-464

The Use of a Spectral Filter Technique for the Identification of Linear and Nonlinear Systems

(Anwendung einer Spektralfiltertechnik zur Identifikation linearer und nichtlinearer Systeme)

W. Wedig

Institut fur Technische Mechanik, Universitat Karlsruhe Kaiserstrasse 12, D-7500 Karlsruhe 1, Bundesrepublik, Deutschland, Ing. Arch., 49 (5/6), pp 413-425 (1980) 4 figs, 7 refs

(In German)

Key Words: System identification techniques, Nonlinear systems, Linear systems, Spectrum analysis

For the identification of dynamic systems random noise should be used which excites all natural frequencies in one test. By means of a simple second order circuit, the bandpass properties of which leads to a delt-filter in the limiting case, it is then possible to measure or to calculate exactly the noise-spectra of all processes and parameters of the system as well.

81-465

Parameter Estimation of Delay Systems Via Block Pulse Functions

Y. Shih, C. Hwang, and W. Chia

Dept. of Chemical Engrg., National Cheng Kung Univ., Tainan, Taiwan, China, J. Dyn. Syst. Meas. and Control, Trans. ASME, 102 (3), pp 159-162 (Sept 1980) 2 figs, 19 refs

Key Words: Parameter identification technique

Linear time-invariant delay-differential equation systems are approximately represented by a set of algebraic equations with block pulse functions. A least squares estimate is then used to determine the unknown parameters. Examples with satisfactory results are given.

DESIGN TECHNIQUES

(See No. 448)

COMPUTER PROGRAMS

(Also see Nos. 218, 232, 268, 269, 291, 292, 293, 364, 367, 417, 418)

81-466

NDTRAN: Interpreter of Dynamic Systems (O Interpretador de Sistemas Dinamicos: NDTRAN)

H.G.V.S. Borges

Instituto de Pesquisas Espaciais, Sao Paulo, Brazil, 64 pp (Mar 1980)

N80-26058

(In Portuguese)

Key Words: Computer programs, Dynamic systems

Computer methods for system dynamic simulation are examined with specific emphasis on the dynamic modeling translator and the Notre Dame Translator. Both are specific for simulation of continuous time.

81-467

CRASHC: A Two-Dimensional Code to Compute the Response of Axisymmetric Shipping Containers to End-on Impacts

T.A. Butler, E.G. Endebrock, and J.B. Payne

Los Alamos Scientific Lab., NM, 46 pp (Jan 1980)

LA-8121-MS

Key Words: Computer programs, Shipping containers, Impact response (mechanical), Axial excitation

Safety evaluation of radioactive material shipping containers entails determining their response to severe impact conditions. A computer code for obtaining the nonlinear response of axisymmetric shipping containers to end-on impact is described.

81-468

Computer Models for Soil Structure Interaction Analyses

J.M. Roesset

The Univ. of Texas at Austin, Austin, TX, ASME Paper No. 80-C2/PVP-130

Key Words: Interaction: soil-structure, Computer programs, Nuclear power plants, Seismic design

A number of formulations and computer programs have been developed in the last years for soil structure interaction analyses, particularly in relation to the seismic design of nuclear power plants. Characteristics of some of these models, the simplifying assumptions which may be inherent in their formulation, the conditions under which they may be used with some degree of confidence and the decisions that must be made in the selection of the appropriate model parameters in order to obtain reasonable answers, are discussed in detail.

81-469
Recent Developments in Computer Methods for Structural Analysis
T.J.R. Hughes
Div. of Engrg. and Applied Science, California Inst. of Tech., Pasadena, CA 91125, Nucl. Engr. Des., 57 (2), pp 427-439 (May 1980) 10 figs, 71 refs

Key Words: Interaction: structure-fluid, Finite element technique, Beams, Plates, Shells, Computer programs

A survey is presented of several areas in which significant recent progress has been made in computerized structural analysis. The areas upon which attention is focused are: new transient algorithms; fluid-structure interaction; and finite elements for nearly-incompressible solids, and beam, plate and shell structures based upon theories which include transverse shear deformations.

81-470
Fatigue Damage of Flexible Pavements under Heavy Loads
J.H. Havens, R.C. Deen, and H.F. Southgate
Div. of Research, Kentucky Bureau of Highways, Lexington, KY, Rept. No. RR-518, 25 pp (Apr 1979)
PB80-197114

Key Words: Computer programs, Pavements, Fatigue life

A modified Chevron N-Layer computer program has the capability of calculating the work done by the total load on a given load group. Earlier analyses of AASHO Road Test sections and test vehicles had permitted the development of damage factor relationships. This paper presents seven two-tire and four-tire single axles, tandems, triaxles, and four-axle, five-axle, and six-axle groups.

81-471
Effects of Cavitation on Underwater Shock Loading. Part 2. Plane Problem
R.E. Newton
Naval Postgraduate School, Monterey, CA, Rept. No. NPS69-80-001, 18 pp (Apr 1980)
AD-A084 755/8

Key Words: Computer programs, Cavitation, Underwater explosions, Shock excitation

Addition of a structural code to the previously developed finite element fluid code is described. Preliminary conclusions concerning conditions needed to induce cavitation and its effects on structural response are reported.

81-472
TRBASIS: A Program Module for Transient Modal Analysis of Linear Structures, Part 1
P. Stehlin
Structures Dept., Aeronautical Res. Inst. of Sweden, Stockholm, Sweden, Rept. No. FFA-HU-2125-Pt-1, 56 pp (Oct 1979)
N80-28762

Key Words: Computer programs, Modal analysis, Transient response, Linear systems

An integrated program module of the BASIS 3 structural analysis code which performs transient analyses of linear structures is described. A summary of the theoretical relations on which the code is based is given. The operation of the program module is explained and illustrated by examples.

81-473
Use of Minicomputers for Dynamic Analysis
D.B. Nickerson
Stress Analysis Associates, La Canada, CA, Test, 42 (5), pp 8-11 (Oct/Nov 1980) 1 fig

Key Words: Design techniques, Computer-aided techniques, Pumps, Beams

The possibilities of microcomputers, equipped with interactive software, to solve dynamic problems are discussed. To illustrate the advantages of the microcomputers, shaft vibrations, a typical problem in vertical pump field, are determined using a large general purpose finite element program (ANSYS), Timoshenko theory, and the microcomputer with BEAMVIBS software.

81-474
Nonlinear Transient Analysis by Energy Minimization: A Theoretical Basis for the Action Computer Code
M.P. Kamat

Virginia Polytechnic Inst. and State Univ., Blacksburg, VA, Rept. No. NASA-CR-3287, 109 pp (July 1980)
N80-26697

Key Words: Computer programs, Transient response, Energy methods, Finite element techniques, Crash research (aircraft)

The formulation basis for establishing the static or dynamic equilibrium configurations of finite element models of structures which may behave in the nonlinear range are provided. With both geometric and time independent material nonlinearities included, the development is restricted to simple one and two dimensional finite elements which are regarded as being the basic elements for modeling full aircraft-like structures under crash conditions.

81-475
ROTOR: A Fortran Program to Calculate the Critical Speeds of Rotating Shafts
P. Brooks and D.L. Duffett
Reactor Equipment Ltd., General Electric Co., Whetstone, UK, Rept. No. REL/R(79)2, REL/TM(78)23, 41 pp (Jan 1979)
N80-26674

Key Words: ROTOR (computer program), Computer programs, Shafts (machine elements), Critical speeds

A computer program is described written in FORTRAN for the PDP 11-70 which can be used to calculate any number of critical speeds of transverse vibration of a rotating shaft supported in two bearings. Operating instructions, method of calculation, comparisons made with other methods of calculation, and test problems are given.

81-476
Steady, Oscillatory, and Unsteady Subsonic and Supersonic Aerodynamics, Production Version (Soussa-p 1.1). Volume 1: Theoretical Manual
L. Morino
Aerospace Systems, Inc., Burlington, MA, Rept. No. NASA-CR-159130, ASI-TR-78-45-V-1, 134 pp (Jan 1980)
N80-26269

Key Words: Computer programs, Aerodynamic characteristics, Green function

Recent developments of the Green's function method and the computer program SOUSSA are reviewed and summarized.

81-477
Vibration Analysis of the Long Duration Exposure Facility (LDEF) Using SPAR
H. Edighoffer
General Electric Co., Philadelphia, PA, Rept. No. NASA-CR-159239, 96 pp (June 1980)
N80-26696

Key Words: SPAR (computer program), Computer programs, Test facilities

The structural modeling of the Long Duration Exposure Facility utilizing the SPAR system of computer programs for vibration analysis is discussed.

81-478
Users Manual: Secondary Data Reduction Programs for the Eclipse S-200/230 Shock and Vibration Measurement Systems
H.W. Swan
Data Processing Div., Sandia Labs., Livermore, CA, Rept. No. SAND-79-8065, 43 pp (Nov 1979)
N80-25708

Key Words: Computer programs, Measurement techniques, Shock response, Vibration measurement

The Eclipse secondary data reduction programs from the user's point of view is described. These secondary processing routines manipulate the data in ways that are outside the scope of the primary reduction routines. Included are logarithms, antilogarithms, and powers of data; polynomial smoothing, dividing and multiplying one data set by another, and scaling; combinations and separation; and others.

GENERAL TOPICS

TUTORIALS AND REVIEWS

81-479
Historical Aspects of the Seismic Analysis of Large Dams

R. Dungar
Motor-Columbus Consulting Engineers, Inc., Parkstrasse 27, CH-5400 Baden, Switzerland, Shock Vib. Dig., 12 (10), pp 3-8 (Oct 1980) 44 refs

Key Words: Reviews, Dams, Seismic design, Concrete construction

Generalities of the aseismic design of dams are reviewed. Specific details related to concrete dams and to embankment structures are presented.

81-480
Damping of Mechanical Vibrations and Acoustic Waves
J.R. Birchak and D. Rader
Acoustic Sensors, NL Petroleum Services, Houston, TX, Shock Vib. Dig., 12 (10), pp 11-30 (Oct 1980) 261 refs

Key Words: Reviews, Vibration damping, Acoustic absorption

An overview of the mechanisms underlying the damping of mechanical vibrations and acoustic waves is presented. References are grouped according to damping parameters, gases, liquids, solids and surface losses at interfaces. Practical implications are summarized to show engineering applications and directions for future investigations of energy dissipation.

BIBLIOGRAPHIES

81-481
Compression Fatigue Life Prediction Methodology for Composite Structures - Literature Survey
C.R. Saff
McDonnell Aircraft Co., St. Louis, MO, Rept. No. NADC-78203-60, 77 pp (June 1980)
AD-A086 062/7

Key Words: Bibliographies, Fatigue life, Composite structures, Prediction techniques

A summary of literature concerning static strength and fatigue analysis of bolted joints in composite materials is given. The objective of this program is to develop a fatigue life prediction methodology that will improve design efficiency, facilitate structural certification and provide guidelines for service life management.

81-482
Acoustic Holography. 1964 - June, 1980 (Citations from the NTIS Data Base)
W.E. Reed
National Technical Information Service, Springfield, VA, 172 pp (July 1980) (Supersedes NTIS/PS-79/0735 and NTIS/PS-78/0700)
PB80-812530

Key Words: Bibliographies, Acoustic holography

Aspects of acoustic holography are covered in this bibliography. Theory, equipment design, uses, and imaging techniques are presented. The applications include underwater and underground object locating, structural geology and tectonics, sonar imaging, non-destructive testing, antenna radiation patterns, nuclear reactor inspection, remote sensing, and use in medical examinations.

81-483
Acoustic Holography. 1970 - June, 1980 (Citations from the Engineering Index Data Base)
W.E. Reed
National Technical Information Service, Springfield, VA, 334 pp (July 1980) (Supersedes NTIS/PS-79/0736 and NTIS/PS-78/0701)
PB80-812548

Key Words: Bibliographies, Acoustic holography

Worldwide research on acoustic holography is covered. Theory, uses, equipment design, and imaging techniques are presented. Most of the studies are general and not applied to a specific use of acoustic holography. However, there are citations which do discuss its use in medicine, nuclear reactors, and nondestructive testing.

AUTHOR INDEX

CALENDAR

MARCH 1981

8-12 28th International Gas Turbine Conference and Exhibit [ASME] Houston, TX *(ASME Hq.)*

21-Apr 1 Lubrication Symposium [ASME] San Francisco, CA *(ASME Hq.)*

31-Apr 1 Pressworking Machinery for the Eighties Conference [IMechE] Birmingham, UK *(IMechE, 1 Birdcage Walk, Westminster, London SW1H 9JJ)*

APRIL 1981

6-8 22nd Structures, Structural Dynamics, and Materials Conference [AIAA, ASME, ASCE, AHS] Atlanta, Georgia *(AIAA, ASME, ASCE, AHS Hqs.)*

6-9 NOISEXPO '81 [S/V, Sound and Vibration] Hyatt Regency O'Hare, Chicago, IL *(NOISEXPO '81, 27101 E. Oviatt Rd., Bay Village, OH 44140)*

27-30 27th Intl. Instrumentation Symposium [Aerospace Industries and Test Measurement Divisions of the Instrument Society of America] Hyatt Regency, Indianapolis, IN *(Jim Dorsey, c/o Measurements Group, P.O. Box 27777, Raleigh, NC 27611)*

MAY 1981

4-7 Institute of Environmental Sciences' 27th Annual Technical Meeting [IES] Los Angeles, CA *(IES, 940 East Northwest Highway, Mt. Prospect, IL 60056)*

31-Jun 5 Spring Meeting and Exhibition of the Society for Experimental Stress Analysis [SESA] Hyatt Regency, Dearborn, MI *(SESA, P.O. Box 277, Saugatuck Station, Westport, CT 06880)*

JUNE 1981

1-4 Design Engineering Conference and Show [ASME] Chicago, IL *(ASME Hq.)*

8-10 NOISE-CON 81 [Institute of Noise Control Engineering and the School of Engineering, North Carolina State University] Raleigh, North Carolina *(Dr. Larry Royster, Program Chairman, Center for Acoustical Studies, Dept. of Mechanical & Aerospace Engr., North Carolina State University, Raleigh, NC 27650)*

22-24 Applied Mechanics Conference [ASME] Boulder, CO *(ASME Hq.)*

SEPTEMBER 1981

1-4 Joint Meeting of the British Society for Strain Measurement and the Society for Experimental Stress Analysis [B.S.S.M. and SESA] Edinburgh University, Scotland *(C. McCalvey, Administration Officer, B.S.S.M., 281 Heaton Road, Newcastle upon Tyne, NE6, 5QB, UK)*

7-11 Applied Modelling and Simulation Conference and Exhibition [I.A.S.T.E.D. and A.M.S.E.] Lyon, France *(A.M.S.E., 16, Avenue de Grande Blanche, 69160 Tassin-La-Demi-Lune, France)*

20-23 Design Engineering Technical Conference [ASME] Hartford, CT *(ASME Hq.)*

28-30 Specialists Meeting on "Dynamic Environmental Qualification Techniques" [AGARD Structures and Materials Panel] Noordwijkerhout, The Netherlands *(Dr. James J. Olsen, Structures and Dynamics Division, Air Force Wright Aeronautical Laboratories/FIB, Wright Patterson Air Force Base, OH 45433)*

OCTOBER 1981

Eastern Design Engineering Show [ASME] New York, NY *(ASME Hq.)*

4-7 International Lubrication Conference [ASME - ASLE] New Orleans, LA *(ASME Hq.)*

11-15 Fall Meeting of the Society for Experimental Stress Analysis [SESA] Keystone Resort, Keystone, CO *(SESA, P.O. Box 277, Saugatuck Station, Westport, CT 06880)*

19-22 International Optimum Structural Design Symposium [U.S. Office of Naval Research and University of Arizona] Tucson, Arizona *(Dr. Erdal Atrek, Dept. of Civil Engineering, Building No. 72, University of Arizona, Tucson, AZ 85721)*

27-29 52nd Shock and Vibration Symposium [Shock and Vibration Information Center, Washington, D.C.] New Orleans, Louisiana *(Henry C. Pusey, Director, SVIC, Naval Research Lab., Code 5804, Washington, D.C. 20375)*

NOVEMBER 1981

15-20 ASME Winter Annual Meeting [ASME] Washington, D.C. *(ASME Hq.)*

30-Dec 4 Acoustical Society of America, Fall Meeting [ASA] Miami Beach, FL *(ASA Hq.)*

CALENDAR ACRONYM DEFINITIONS AND ADDRESSES OF SOCIETY HEADQUARTERS

AFIPS: American Federation of Information Processing Societies
210 Summit Ave., Montvale, NJ 07645

AGMA: American Gear Manufacturers Association
1330 Mass Ave., N.W.
Washington, D.C.

AHS: American Helicopter Society
1325 18 St. N.W.
Washington, D.C. 20036

AIAA: American Institute of Aeronautics and Astronautics, 1290 Sixth Ave.
New York, NY 10019

AIChE: American Institute of Chemical Engineers
345 E. 47th St.
New York, NY 10017

AREA: American Railway Engineering Association
59 E. Van Buren St.
Chicago, IL 60605

ARPA: Advanced Research Projects Agency

ASA: Acoustical Society of America
335 E. 45th St.
New York, NY 10017

ASCE: American Society of Civil Engineers
345 E. 45th St.
New York, NY 10017

ASME: American Society of Mechanical Engineers
345 E. 45th St.
New York, NY 10017

ASNT: American Society for Nondestructive Testing
914 Chicago Ave.
Evanston, IL 60202

ASQC: American Society for Quality Control
161 W. Wisconsin Ave.
Milwaukee, WI 53203

ASTM: American Society for Testing and Materials
1916 Race St.
Philadelphia, PA 19103

CCCAM: Chairman, c/o Dept. ME, Univ. Toronto,
Toronto 5, Ontario, Canada

ICF: International Congress on Fracture
Tohoku Univ.
Sendai, Japan

IEEE: Institute of Electrical and Electronics Engineers
345 E. 47th St.
New York, NY 10017

IES: Institute of Environmental Sciences
940 E. Northwest Highway
Mt. Prospect, IL 60056

IFToMM: International Federation for Theory of Machines and Mechanisms
U.S. Council for TMM
c/o Univ. Mass., Dept. ME
Amherst, MA 01002

INCE: Institute of Noise Control Engineering
P.O. Box 3206, Arlington Branch
Poughkeepsie, NY 12603

ISA: Instrument Society of America
400 Stanwix St.
Pittsburgh, PA 15222

ONR: Office of Naval Research
Code 40084, Dept. Navy
Arlington, VA 22217

SAE: Society of Automotive Engineers
400 Commonwealth Drive
Warrendale, PA 15096

SEE: Society of Environmental Engineers
6 Conduit St.
London W1R 9TG, UK

SESA: Society for Experimental Stress Analysis
21 Bridge Sq.
Westport, CT 06880

SNAME: Society of Naval Architects and Marine Engineers
74 Trinity Pl.
New York, NY 10006

SPE: Society of Petroleum Engineers
6200 N. Central Expressway
Dallas, TX 75206

SVIC: Shock and Vibration Information Center
Naval Research Lab., Code 5804
Washington, D.C. 20375

URSI-USNC: International Union of Radio Science - U.S. National Committee
c/o MIT Lincoln Lab.
Lexington, MA 02173

PUBLICATION POLICY

Unsolicited articles are accepted for publication in the Shock and Vibration Digest. Feature articles should be tutorials and/or reviews of areas of interest to shock and vibration engineers. Literature review articles should provide a subjective critique/summary of papers, patents, proceedings, and reports of a pertinent topic in the shock and vibration field. A literature review should stress important recent technology. Only pertinent literature should be cited. Illustrations are encouraged. Detailed mathematical derivations are discouraged; rather, simple formulas representing results should be used. When complex formulas cannot be avoided, a funtional form should be used so that readers will understand the interaction between parameters and variables.

Manuscripts must be typed (double-spaced) and figures attached. It is strongly recommended that line figures be rendered in ink or heavy pencil and neatly labeled. Photographs must be unscreened glossy black and white prints. The format for references shown in DIGEST articles is to be followed.

Manuscripts must begin with a brief abstract, or summary. Only material referred to in the text should be included in the list of References at the end of the article. References should be cited in text by consecutive numbers in brackets, as in the example below.

> Unfortunately, such information is often unreliable, particularly statistical data pertinent to a reliability assessment, as has been previously noted [1].
>
> Critical and certain related excitations were first applied to the problem of assessing system reliability almost a decade ago [2]. Since then, the variations that have been developed and the practical applications that have been explored [3-7] indicate that . . .

The format and style for the list of References at the end of the article are as follows:

- each citation number as it appears in text (not in alphabetical order)
- last name of author/editor followed by initials or first name
- titles of articles within quotations, titles of books underlined
- abbreviated title of journal in which article was published (see Periodicals Scanned list in June and December issues)
- volume, number or issue, and pages for journals; publisher for books
- year of publication in parentheses

A sample reference list is given below.

1. Platzer, M.F., "Transonic Blade Flutter - A Survey," Shock Vib. Dig., 7, pp 97-106 (July 1975).
2. Bisplinghoff, R.L., Ashley, H., and Halfman, R.L., Aeroelasticity, Addison-Wesley (1955).
3. Jones, W.P., (Ed.), "Manual on Aeroelasticity," Part II, Aerodynamic Aspects, Advisory Group Aeronaut. Res. Devel. (1962).
4. Lin, C.C., Reissner, E., and Tsien, H., "On Two-Dimensional Nonsteady Motion of a Slender Body in a Compressible Fluid," J. Math. Phys., 27 (3), pp 220-231 (1948).
5. Landahl, M., Unsteady Transonic Flow, Pergamon Press (1961).
6. Miles, J.W., "The Compressible Flow Past an Oscillating Airfoil in a Wind Tunnel," J. Aeronaut. Sci., 23 (7), pp 671-678 (1956).
7. Lane, F., "Supersonic Flow Past an Oscillating Cascade with Supersonic Leading Edge Locus," J. Aeronaut. Sci., 24 (1), pp 65-66 (1957).

Articles for the DIGEST will be reviewed for technical content and edited for style and format. Before an article is submitted, the topic area should be cleared with the editors of the DIGEST. Literature review topics are assigned on a first come basis. Topics should be narrow and well-defined. Articles should be 1500 to 2500 words in length. For additional information on topics and editorial policies, please contact:

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